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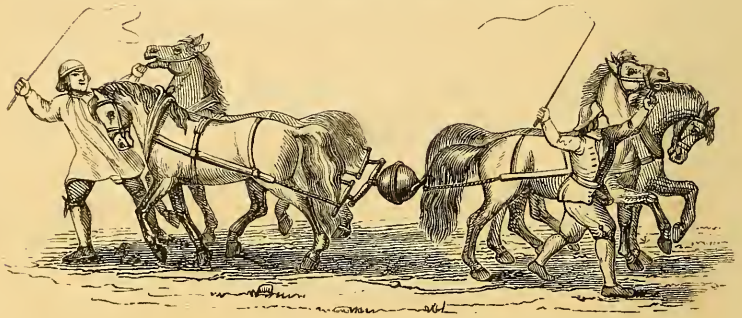

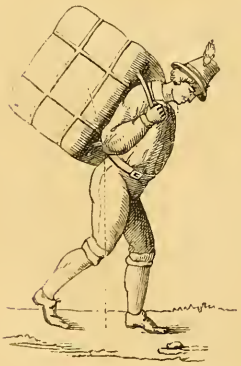

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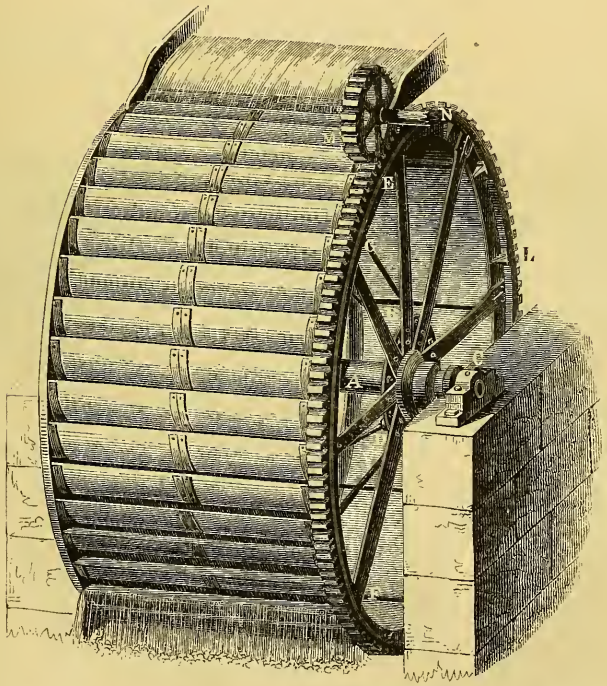

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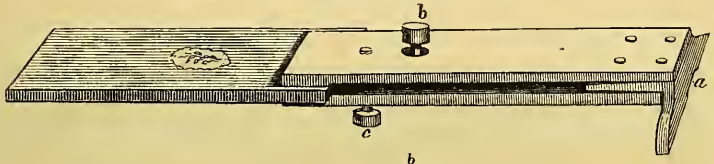

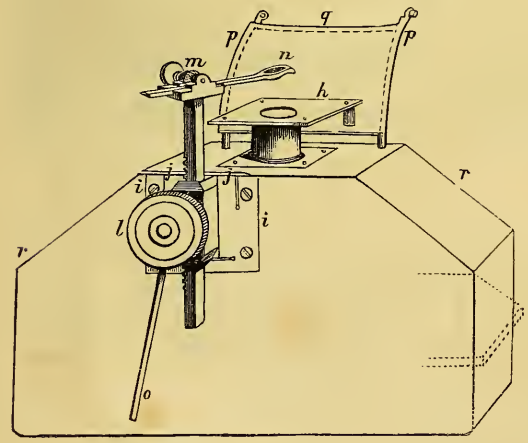

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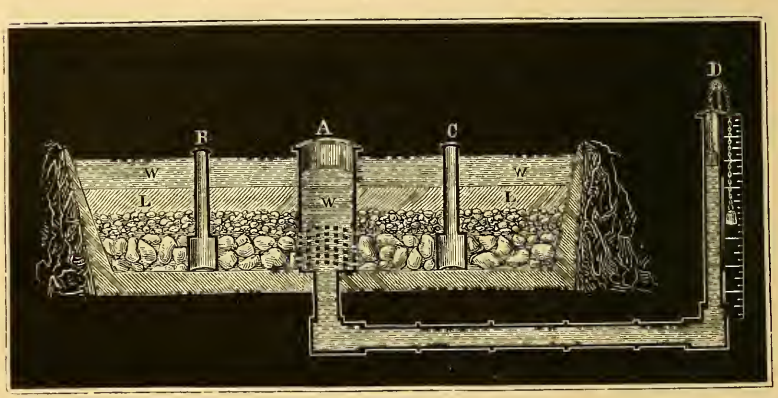

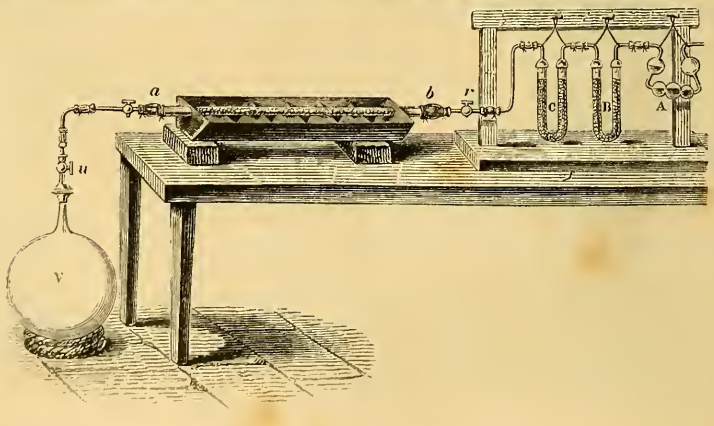

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* Of the tides.

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ADVERTISEMENT.

I AM most deeply indebted to Charles Simpson, Esq. Surgeon, of Stamford, for the Diagrams which illustrate this work. These Diagrams owe their effect, in an equal degree, to Mr. Simpson's accurate knowledge of the subject, and his skill as a draughtsman; a combination rarely to be found in medical drawings.

I must add that, in these drawings, the *object* displayed is all that is claimed by me; and that the *skill* and *spirit* with which they are displayed is entirely due to Mr. Simpson.

I expect that Mr. Simpson will prove the *practical* value of the principles detailed in this volume, by the publication of a series of *Cases* in illustration of their immediate application to the *diagnosis* and *treatment* of the diseases of the Nervous System.

PREFACE.

1. I PROPOSE in this preface to take a short retrospective survey of the origin and course of my investigations, and of the reception which they have met with in this country. If any one think that this is an unnecessary procedure, let him imagine himself placed in the situation of one totally and unjustly deprived of his most just *rights*, and of every kind of reward, in regard to labours now acknowledged to be of great importance to the profession and to the public.

2. Whilst engaged, many years ago, in my researches into the Circulation of the Blood, I incidentally observed a remarkable phenomenon: the separated tail of the eft *moved* on being irritated by the point of the scalpel. My friend, Mr. Henry Smith, was present on this occasion, and on the various other occasions, on which my preceding and subsequent experiments were made, both on the circulating and nervous systems.

3. I soon found that similar observations had been recorded by various physiological writers,—Redi, Whytt, Prochaska, Mr. Mayo, &c. &c. But I observed that, in their hands, they had remained useless and sterile,—having led to no conclusion,—having neither been traced backwards to any *physiological principle of action*, nor forwards to any *function in the animal economy*. I conceived it *impossible* that any

such phenomenon should exist in nature without such connection, and I resolved to pursue the subject.

4. I wrote to Mr. Children, the Junior Secretary of the Royal Society, communicating to him the subject of my new investigation. I forwarded to him my *first* Memoir, which was published in the Philosophical Transactions, having been read on June the 20th, 1833*. Between three and four years afterwards I sent my *second* Memoir to the same gentleman. It was read before the same learned body on February the 16th and 23rd, and March the 2nd, 1837. To my utter astonishment, and that of all my friends, this Memoir was refused a place in the Philosophical Transactions! In the mean time, some disputes had arisen between Dr. Roget, the Senior Secretary, and several other gentlemen. With these disputes I had *no* personal concern. I merely bore the testimony to certain facts afforded by a letter in my possession from one of the parties. I do not think it incumbent upon me to enter more fully into the history of this affair. It is enough to have shown that *private* feelings were not excluded.

5. At this distance of time, I still find it difficult to imagine how all this should influence the fate of my paper at the Royal Society, which must have been good or bad, worthy or unworthy of a place in the Philosophical Transactions, and of rewards which the munificence of the Sovereign and the liberality of individuals have placed at the disposal of this learned body in trust, irrespective of the merit of these disputes. The generous testimony borne to the merits of that Memoir by the physiologists of Germany, France, Italy, America, &c. and time and the event even in this country, have determined the question, and that rather differently. But the baneful influence of the decision of the Council of the Royal Society exposed me, for a long time, to every kind of contumely†. I can only add, on this subject, the words of Schiller,—

"Unbilliges erträgt kein edles Herz." WILHELM TELL.

---

* I had read a notice on the subject before the Zoological Society, in 1832.

† Besides the facts to which I have alluded, there *is* one which I should be very unwilling to publish; but there is another which I think it right to record.

6. I have briefly referred, § 190, to the incomprehensible treatment which my labours *early* received from various quarters. I might, alas! say much more; but I refrain. The story would only remind us of the dark times of science, and, indeed, of the treatment of our own illustrious Harvey, between whom and Dr. Ent, who visited him on one occasion in his retirement, the following interesting conversation is recorded:—

7. "Many learned and judicious men (said I, interrupting him,) acquainted with your unwearied industry in the advancement of philosophy, speedily expect the communication of your further experiments."

8. "And would you then advise me (smilingly replied the Doctor) to quit the tranquillity of this haven, wherein I now calmly spend my days, and again commit myself to the unfaithful ocean? You are not ignorant how great troubles my lucubrations, formerly published, have raised. Better it is, certainly, to endeavour to grow wise at home in private, than, by the hasty divulgation of such things, to the knowledge whereof you have attained with vast labour, to stir up tempests that may deprive you of your leisure and quiet for the future.

9. "Yes, but (answered I) to deserve well and receive ill is the usual reward of virtue; and the winds which raised these your troubles, have, like the wind Cæcias, drawn mischief upon themselves.

10. "With that he shewed me his Exercitations*."

11. I have now the pleasure of stating that my labours have recently met with a very different reception; and I must, in particular, add to the names of my pupil, Mr. F. W. Barlow, and of Mr. F. Le Gros Clarke, (as of two gentlemen who, *before* Prof. Müller's sanction of my views

---

Appended to a paper of Mr. Newport, in the Philosophical Transactions, there is a wily note, containing an injurious insinuation against me which Mr. Mayo and Mr. Kiernan can prove to be unfounded. On first reading it, I instantly dispatched a messenger to the new Junior Secretary, Mr. Christie, requesting that it might be expunged. It remains, nevertheless, a blot upon those pages, which ought to be dedicated to TRUTH alone. I must add, that this stranger (Mr. Newport) I long treated as a brother. He repaid me with black ingratitude.

* See Anatomical Exercitations concerning the Generation of Living Creatures, &c. London, 1653. Preface.

was known in this country, perceived and avowed their importance and novelty with a candour which I would gladly see prevail in every philosopher,) those of Dr. Holland and of Prof. Sharpey (see p. 232, note), whose generous expressions of approbation have more recently cheered my laborious path. But I mention with peculiar satisfaction the kindness and liberality of Dr. Watson, from whose Lecture, published in the Medical Gazette for February the 16th, 1841, I make the following extract, as the most gratifying reward of my labours :—

12. "It is no part of my purpose to enter into any history of the steps by which this curious problem has been worked out. Its solution is an achievement of our own time, and I may add, of our own country. I profess no more than to sketch, in mere outline, the leading facts that have been ascertained; yet I must, in passing, pay the tribute due to one indefatigable labourer in this department of science, whose sagacity has enabled him to seize the clue, and in a great measure to unfold the mazes, of the labyrinth in which this part of the physiology of the nervous system was so long entangled. Dim and uncertain glimmerings of the truth appear in the writings of bygone authors; but it was never clearly discerned, and plainly stated, and successfully applied to the elucidation of a large class of disorders, until the publication, in 1832 and 1833, of Dr. Marshall Hall's ingenious and most interesting researches into 'the functions of the medulla oblongata and spinal cord.' Similar views appear to have suggested themselves, about the same time, to Professor Müller of Berlin. I must recommend you to study the works of these authors; and I may also point out, as fit writings for your perusal (since the doctrines I am now speaking of are comparatively new), Mr. Grainger's *Observations on the Structure and Functions of the Spinal Cord;* Dr. Carpenter's *Inaugural Dissertation on the Physiological Inferences to be deduced from the Structure of the Nervous System in the Invertebrated Classes of Animals;* and a very able paper on the Pathology of the Spinal Cord, by Dr. William Budd, in the 22nd volume of the *Medico-Chirurgical Transactions.*

13. "If, on the other hand, you wish to see how nearly the idea, which has been so happily simplified into an intelli-

gible principle by Dr. Hall, was reached by earlier observers, you may consult the writings of Dr. Whytt, upon nervous diseases."

14. I must now beg to state quite frankly that I do not think there has been any desire recently to depreciate my labours, on the part of the principal writer in the British and Foreign Medical Review (Dr. Carpenter). It is already acknowledged, even by this gentleman, that my discovery ranks *with* that of Sir Charles Bell in anatomy and physiology, and is of *still greater value* in its relation to pathology and therapeutics, whilst it constitutes the "*third great era* in the history of neurology*;" &c. Greater praise than this I am sure I need not desire. But, if a tithe of this be true, most assuredly my labours ought to have experienced a *very* different reception from that which has been allotted to them!—some little welcome and favour in the place of violent opposition and injustice. And though these expressions may appear like the reparation of a wrong, they are not so in fact. The former criticisms, being anonymous, did me serious injury, kept my opponents at the Royal Society in countenance, and diffused an unfavourable impression through the profession, relative to the value of my labours,—an impression which is only now fully removed. Full reparation, in such a case, cannot be made: in the first place, admitting that it is at length frankly attempted, yet the *delay* itself is injustice; and, in the second place, the reparation is never complete, the injury never completely remedied. The stab is not the less injurious because we may afterwards endeavour to heal the wound we have inflicted. If I had no other reason for complaint, this would be sufficient,—that I am called upon to make the present painful statement, instead of pursuing the course of my investigations and publications in peace and quietness.

15. Then there is a waywardness about my young critic which I cannot comprehend. For example, in the number of the Review in question which has just appeared, I am again entirely misrepresented. I beg my readers to refer to §§ 1219, 1228, &c. of the present volume. The question is,—is there, in *disease* or *injury* of the *spinal marrow*, any mor-

* See vol. viii, p. 511; ix, 104, 580; xi, p. 453.

bid action in limbs or parts receiving their nerves from *above* the seat of that disease or injury? In other words, is the disease always seated *above* the limbs affected*? It is a question of *diagnosis*, a question of *practical import;* one which must determine *where we should apply our remedies!* On *this* subject my young critic makes the following observations:

16. "The remainder of Dr. Hall's second Memoir is occupied with an inquiry into the *retrograde* action, as he terms it, of stimuli acting on the spinal system of *nerves*" (!) &c. &c. &c. Now, what can be said of writings which confound *disease* or *injury* of the *spinal marrow itself*, with *stimuli* applied to the spinal system of *nerves?* Then follows a statement more dogmatic and dictatorial than wise:—"To ourselves the matter appears quite simple (!). In the *true spinal cord* there is no such thing as *direct* and *retrograde* (!) terms, which only apply to that portion of it which consists of prolongations of the *cerebral* fibres," &c. (!) The detail of an experiment, the observation of a disease, afford the reply to these dicta. If we remove the head of a tortoise, and divide and stimulate that part of the spinal marrow which is *below* the origin of the brachial plexus, and *above* that of the crural, *both* anterior and posterior extremities are made to move. See § 1222, and the note below. Is there really "no such thing as *direct* and *retrograde in the true spinal cord?*"

17. A criticism next follows, on the subject of volition, emotion, and the vis nervosa of Haller, as distinct principles of muscular action, and distinct and important subjects of clinical observation. My critic says:—"In this enumeration we cannot but think there is some confusion: if the *vis nervosa* of Haller be intended, this is alike the means by which volition, emotion, and simple reflex action produce muscular movement." How does my young critic know this? It may be, or may not be so. But especially, what has this knotty point to do with the question as a *practical* one, as one of observation and pathology? The arm is paralysed to volition: it is shaken by emotion; it is contracted by the constant action of the *vis nervosa*. Are not

* Dr. Bieger has inserted a Chapter in his Inaugural Dissertation (Bonn, 1832) with this title: "Observationes in quibus affectæ erant partes, quæ supra læsam regionem medullæ spinalis, locum habebant."

these interesting topics? Have they been examined before? Do they not explain much of the diseases of the nervous system? Some critics, especially the young ones, think they must necessarily find fault. The *distinct* influences of volition, of emotion, of the *vis nervosa*, and of the irritability of the muscular fibre, are well worthy the investigation of the pathologist and the practitioner. By this investigation, the pathology and the practice will, I trust, be improved; and these are more important matters than disputatious criticisms.

18. But there is another point which I must notice here, and a little more particularly, on account of its importance. It is that discussed in the following pages, from § 203, 242, and illustrated in *Plate* III, *fig.* 2, 3, 4, 5. On this subject, my critic observes, after using the word "arguments," instead of the words *facts* or *experiments*,—"There is *no proof whatever* that a *motor influence* ever travels along *incident* nerves (!). All we know of the matter is, that the incident or afferent nerves, when excited at their *peripheral extremity*, produce a *change* in the central ganglion (the true spinal cord of vertebrata), *by which* a motor influence is propagated along the efferent nerves; and, for any thing we know"—"the nature of the changes taking place in the incident and motor nerves, may be as different as the direction of their propagation*."

19. Now, in the first place, my detail is not one of "arguments," but, as I have stated, of *facts*, of *experiments*, of experiments of which neither M. Flourens nor Prof. Müller has disdained to make use, although, as I think, imperfectly and inconclusively. See § § 233, 239.

20. In the next place, my critic has failed to do any thing more than give an *ex-cathedra* opinion, a sort of *veto*. Whether this opinion will change, as all the rest of this young critic's opinions have done,—as *time elicits truth*,—remains to be determined. Besides what "may be," *may* not be. Meantime, I confidently believe that my *experiments* have not only confirmed my first opinion, formerly equally combated, that the reflex actions do *not* result from *sensation*; but that, whilst they demonstrate what the principle of action in those movements *is not*, they have established what it *is*.

* Op. cit. p. 523.

21. If we irritate the spinal marrow in the decapitated tortoise between the origins of the brachial and crural plexuses, *both* brachia and crura, as I have said, are moved! If Dr. Carpenter chooses to dispute about this matter, and say, that though there be but *one* application of a stimulus (whether this be the point of a needle, the scalpel, galvanism, heat, a grain of salt, &c.), yet there are *two* powers, or modes, of action, I can only leave him to the unmolested enjoyment of his opinion; begging, at the same time, that he will grant the like privilege to me.

22. But if, instead of exciting a point in the spinal marrow, intermediate between the brachial and crural plexuses, we stimulate an *incident* nerve proceeding to such point, we obtain a *similar* result. Is this a *third* power, a *third* mode of action? Is such an idea philosophical? Is it Newtonian? Still, if Dr. Carpenter prefers this mode of thinking, I would not disturb his dreams; only I think he should not state them quite so dogmatically and dictatorially.

23. To me it appears that the motor power acts along an incident nerve, as the vibrations of a ray of light or sound pursue their incident course; that the true spinal marrow induces a sort of *polarization*, and directs this motor force in new but defined courses of double or multiplied refraction or reflexion, inscrutable in their essence, and only to be ascertained by their effects in the destined and definite movements they induce.

24. The influence of a stimulus applied to an incident nerve, may also be *compared* to *induction* in the case of electricity. This affects the remotest parts of a conductor, or series of conductors, placed in relation with its excitor, according to definite laws, ascertained by observation alone.

25. I judge that *one* principle, the *vis nervosa* of Haller, acting according to *laws* newly discovered, is *the* motor power in *all* these experiments; and not only in *these* experiments, but in those (long known to physiologists) of the reflex actions; and, as a consequence, in *all* the acts of ingestion and egestion in the animal economy,—a series of phenomena as I have stated, hitherto unexplained, hitherto untraced to *any* principle. I must also repeat that the application of this

principle is not limited to physiology. It has a further, most important application to pathology and therapeutics.

26. I regard this *generalization*, indeed, as the most happy result of my inquiries.

27. An admitted principle of action, hitherto merely known as an *experiment*—a mere *toy* in the hands of the physiologist,—proves to be the grand motor principle in *all* the acts of exclusion, of ingestion, of expulsion, in animated being! Other *experiments*—mere *toys* also—viz. the reflex actions, in the hands of Redi, Whytt, &c. equally unexplained and unapplied, receive both their explanation and their application through the medium of the same principle! —See *Plate* III, *figs.* 2—5.

28. In all this, *I* admire the hand of Him who fashioneth all things after His own will; in all this I see design, power, creation! As one mighty principle pervades, and rules throughout the wide universe, so *one* principle (I dare not call it less than mighty) rules in the microcosm of each animated being!

29. I can discover no reason for thinking that the true spinal system differs, either in its essential structure, or properties, in any of its parts, from its minute origins in the nervo-cutaneous and nervo-mucous surfaces, in its incident, in its central, in its reflex portions, or in its ultimate distributions in the muscular or nervo-muscular fibres. All is mere difference of *form*—mere morphology. The structure, the animating principle, is the same in each and every part, only modified in the incident, central, and reflected portions. In every part of this system the *vis nervosa* is seated, is operative; and we really know nothing of the matter except the *facts*, which *experiment* and *observation* bring to light, however the biblio-physiologist may dogmatise on the subject.

30. Is there not, after all, under the guise of this criticism, some latent hypothesis to suit the terms *afferent* and *efferent?* Now nerves are *not* mere *carriers*. A muscular nerve *has* the motor power within itself; so has the spinal marrow; and, as I have recently discovered and proved, so have the incident nerves! Again, I say, I speak but of *facts*—which no physiologist *can* reject; and I let these facts speak their own language. The terms incident and reflex are still the best

terms, in my opinion, which have been devised*. Borrowed from the sciences of optics and acoustics, they express phenomena, without including any hypothesis.

31. Many circumstances still require investigation in the nervous system; and if I might be allowed to advise one who has so often vouchsafed his advice to me, I would say that investigation would be at once a more profitable and more suitable occupation for a youth, than criticism.

32. One circumstance, to which I have not hitherto alluded, is most remarkable: *from* the point of their origin in the cutaneous textures, *to* that of their distribution in the muscular, the minutest incident and reflex nerves are closely accompanied by an artery! This fact I have ascertained in the transparent tissues of the frog. It is too remarkable and too frequent (not to say constant), not to be the result of design. Now it has been proved, by Sir A. Cooper, that the incessant flow of blood along the vertebral arteries is essential to the continuance of the functions of the medulla oblongata (§ 430)†; a fact which confirms the previous observation of Sir C. Bell on the important provision made for the circulation within the spinal canal. May not the juxta-position of an artery be equally necessary to the function of incident and motor nerves? May something comparable to a galvanic influence be so generated? May an *arterial* circulation in the stomach and a *venous* circulation in the liver, in this manner lead to the evolution of acid and alkali, respec-

* If I were disposed to innovate and to propose a new designation for the motor power and function of the true spinal system, I would suggest that of the Greek word, κινησις, *kinesis*, a term used by Aristotle and Galen. *Kinesis* being the substantive, *kinetic* would present us with the adjective form; *akinesis* and *akinetic* would indicate the *absence* of this property, as in the cerebrum and cerebellum, the olfactory, the optic, the acoustic nerves, &c.; *synkinesis* and *synkinetic* would replace the contradictory phrase "sympathetic action;" *parakinesis*, and *parakinetic* do already signify the effect of *emotion*. The true spinal marrow, viewed as the source of *tonic* action, would be *auto-kinetic*, and viewed as the centre of the reflex actions, it would be *dia-kinetic*, the incident nerves being *ento-kinetic*, the reflex nerves, *ecto-kinetic*. The entire system would be *egertico-kinetic*, *eckinetic*, or simply *kinetic*.

† He observes—"I placed a ligature round both vertebral arteries. When I tied the first, there was some difficulty in breathing; but when I tightened the second, this difficulty was greatly increased. The respiration was at first slow, but it afterwards became quicker. The animal retained volition and sensation, but its fore legs were weakened, &c."—Guy's Hospital Reports, vol. i. p. 463.

tively? May this be a reason for the slow digestion during hibernation, in which the blood is, in reality, neither arterial from the influence of respiration, nor venous from that of nutrition and secretion, &c. But all this is mere conjecture. One of the greatest philosophers of the day has, however, indulged himself in similar suggestions*. Compare § 141.

34. I trust I have not allowed one expression to escape me which should give the slightest pain. I would willingly return good for evil—and who, on referring to *many* early volumes of the British and Foreign Medical Review, will not confess that I have been the subject of much gross and unfounded calumny in it? Papers were sent to a friend; were returned with the observation that they were unjust; and were, nevertheless, inserted! In parting with that Review, I trust for ever, I would just repeat, what I have said before, that I think the proceedings of its editor, Dr. Forbes, unjustifiable. Truth, honour, and justice are sacrificed on the altar of pert folly, vanity, and insolence. In the *last* number, even the work of Dr. Prout—the labour of *thirty* years of one acknowledged to be a most profound thinker, accurate observer, and indefatigable investigator—is "cut up," by one of these boy-critics! Proh pudor!

35. I purpose, in my quarto volume, to do Dr. Carpenter ample justice for *his* share in these inquiries. I fear, however, I may not attribute all the importance to them which a youthful author may be excused for doing, especially as I think the *idea* which prevails in them (and it is to be observed that they are reasonings on the facts adduced by others, not investigations) was already amply expressed by myself. Besides, as to the question itself, whether there be a distinct anatomy (however blended in the same sheaths) for the cerebral and true spinal systems, I still think the most unequivocal proof is afforded by experiment and disease. The cerebrum is the centre of one system, the true spinal marrow of the other. Remove the former, and with it are separated sensation and volition, whilst the reflex actions continue. Remove the latter, and these cease in their turn. Are not the conclusions from these facts as plain as the beams of a meridian sun?

36. It is a most interesting question, in regard to the

* Herschel's Discourse on the Study of Natural Philosophy, p. 343, note.

function which remains when the cerebral functions are thus annihilated—through what *channels* does it act? If the cerebrum be the essential centre of the cerebral system of nerves; and if another function remains when this centre is removed, must there not be *another* centre, another set of nerves, its appropriate channels of action?

37. Is any further demonstration of a distinct anatomy *required*, than these physiological facts? From the commencement of this investigation, I have been of opinion, that, as a necessary deduction from these facts, there must be a system of incident and reflex nerves, as distinct from the cerebral nerves of sensation and voluntary motion, as their centre is from the cerebrum.

38. But, besides this argument, a thousand others crowd upon us whilst discussing this subject; I cannot express these better than in the words of my second Memoir, p. 49—:

39. [The entire medulla spinalis in the *Vertebrata* consists then of *two* portions, so intimately blended together, indeed, as not to be easily separated by the anatomist, and, perhaps, only to be distinguished by physiological experiment and pathological observations. The *first* of these is the intra-vertebral *cord* of sentient and voluntary *nerves*, which proceed *to* and *from* the *cerebrum* as their centre. It is represented *Plate* II. *fig.* 1. The *second*, which may be denominated the *true spinal marrow*, is distinguished by being *excito-motory*, and is the axis of a peculiar system of excitor and motor, or excito-motory nerves, generally, but perhaps not invariably, blended with the former. This is represented *Plate* I.

40. The close combination of these two portions of the nervous system, in the *Vertebrata*, is the consequence of the necessity for the several pairs of compound nerves being *inter-vertebral* in their exit from the spinal canal. In the *Articulata* this necessity does not exist, and the two systems may, therefore, be anatomically, as well as physiologically, distinct. Indeed, I think I have ascertained that, whilst the ganglionic nerves in the lobster are incident and excitor, and the columns both direct and retrograde in their influence, the aganglionic nerves are purely motor (as Prof. Grant first conjectured), and direct in their mode of action.

41. These observations lead naturally to the question,—Is there, in any class of animals, a distinct *Anatomy* of the excito-motory power? Are there excitor nerves distinct from nerves of sensation? Are there motor nerves distinct from nerves of volition?

42. In the first place, I may observe that the olfactory, optic, and acoustic nerves, are nerves of *sense* only, and destitute of excito-motory power. See p. 314, *note* ‖. So are the cerebrum and cerebellum, the former of which is probably the centre of the sentient and voluntary system. Is there a pure *voluntary* nerve?—a nerve which conveys the acts of the will, without possessing the motor or excito-motory power? It appears to me, that *one* such purely voluntary nerve may exist; for every muscle of the animal frame, with this exception, seems to require *tone*, which is a result of the excito-motory power, conveyed by motor nerves, probably involved, in general, in the same neurilemma with voluntary nerves. This power acts during *sleep*,—in *all* muscles, *except the levator palpebræ*, and perhaps the four *recti* oculi.

43. But as there are purely sentient nerves, it may be a question whether there be purely excitor nerves. Such a nerve probably does not exist absolutely in health. An experiment made by Mr. Broughton, Mr. Field, and myself, in 1835, led to the conclusion that the *pneumogastric* nerve is destitute of sentient property. This nerve is certainly the least sentient, and the most purely excitor, of any in the class *Vertebrata*. In certain cases of disease, we, however, observe the sentient power annihilated, whilst the excito-motory still continues: this occurs in those diseases of the brain which destroy the sensibility of the face; the excito-motory property may remain, and the eye-lash and the nostril be as susceptible of stimuli as ever. In the experiments in which the cerebrum, the *centre* of the sentient and voluntary system, is removed, and in diseases and in other experiments in which the upper parts of the spinal marrow is disorganized or divided, the phenomena which remain are entirely of the excito-motory class. Sentient and voluntary nerves are blended with the excitor and motor nerves; but their functions are suspended, when the influence of the centre of this system is cut off. The centre of the excitor and motor nerves being the

appropriate portions of the spinal marrow itself, the functions of these nerves remain.

44. Still the two sets of nerves are generally blended anatomically. If they be distinct in any class of animals, it is probably in the *Invertebrata*, and especially in their lowest forms, in which sensation and volition are nearly extinct, and the animal lives a sort of excito-motory life only.

45. But if the existence of a *distinct* anatomy of the excito-motory system be doubtful, that of the *blended* anatomy, and that of the distinct physiology, pathology, and therapeutics of this system, are perfectly obvious.]

46. My readers may compare §§ 89—96; 148—150; in the subsequent pages.

47. I have, in sending forth this little volume, to repeat that my object has uniformly been to lay before my readers *the practical application* of my views of the nervous system. I have, therefore, treated those subjects briefly, the application of which was not obvious or immediate, reserving their further discussion for my larger volume; whilst I have entered more into detail in treating those points which were calculated to elucidate the nature, diagnosis, and treatment of diseases.

48. If I have pointed out new paths which we should pursue in detecting the dawn and watching the progress of an important class of diseases; if I have suggested new plans of prevention and of treatment, I shall not, I think, have failed in my object of being useful to the practitioner and to mankind.

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ON THE

DISEASES AND DERANGEMENTS

OF

THE NERVOUS SYSTEM.

INTRODUCTORY OBSERVATIONS.

1. Reserving for another work*, in a larger form, the fuller development and illustration of the philosophy of the Nervous System, I purpose, in the following pages, to treat of its organic diseases and functional derangements, with only such a brief account of the physiology as may be necessary to the comprehension of the pathology of those morbid affections.

2. It is many years since I first made the nervous system, in its anatomical, physiological, pathological, and therapeutic and practical relations, the special subject of research, by experiment, and still more by observation. The subject is so extensive and intricate, that, even after so considerable a period, I am only able to publish a sketch of the plan and objects of my investigation, the maturer results of which I still purpose to submit in succession to the notice of my professional brethren.

3. The preceding paragraph, written in 1835, and pub-

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* On the Nervous System, its *Anatomy*, *Physiology*, and *Pathology*, and the *Action of Remedies*, in 4to. illustrated by a series of most able and elaborate *Diagrams* by Charles Simpson, Esq. Surgeon, of Stamford, to whom I am also indebted for the spirited *Outlines* in the present volume.

lished in the first edition of my Lectures on the Nervous System and its Diseases, is still true in 1841. Nevertheless, much progress *has* been made in this inquiry during the interval; and the time *is* arrived when we may freely assert, that, to understand the diseases and derangements of the nervous system, we must understand and *apply* the views of its physiology and pathology, in its subdivisions, recently traced and established, amidst much discreditable and, for the time, injurious opposition, (see § 190) by my own exertions. It is not less necessary to observe the mutual influence of the nervous and the vascular and general systems, and the several organs and their functions.

4. I shall proceed to sketch these subjects of inquiry, before I enter upon them more particularly. I shall afterwards treat of the diseases of the different parts of this system; and I shall then draw particular attention to the more general derangements of the system, viewed first as a whole, and then in its connections with the other systems and organs of which the human frame is composed.

5. The Nervous System has long been divided into—

1. *The Cerebro-Spinal, and*
2. *The Ganglionic or Sympathetic;*

to which the *Respiratory* has recently been added by Sir Charles Bell.

6. I think I have sufficiently proved the propriety, and indeed the necessity, of another subdivision of the Nervous System. Viewing the cerebral or cerebro-spinal portion of the nervous system as the organic seat of *mind*,—of *sensation, perception, judgment,* and *volition*,—and the ganglionic as that of the source of *the movements of the internal muscular organs,* of *nutrition, secretion,* &c. it has become obvious that there is an intermediate portion of this system, not formerly known; viz. that of *all the functions of ingestion and egestion, of exclusion, retention, expulsion,* &c. This subdivision of the nervous system includes the respiratory system of Legallois and Sir Charles Bell under a new aspect. I have designated it, for the present, from its organic seat, and the uniform mode of its action, the true-spinal and excito-motory. The nervous system must, therefore, now be divided into—

I. *The Cerebral, or that of Sensation and Volition;*

II. *The True Spinal, or that of the Movements of Ingestion and Egestion;* and

III. *The Ganglionic, or that of the Movements of the Internal Muscular Organs, of Nutrition, Secretion, &c.*

7. The principle of action in the cerebral system is the ψυχη, or the immortal *soul.* Upon the cerebrum the soul sits enthroned, receiving the ambassadors, as it were, *from* without, along the *sentient nerves;* deliberating and willing; and sending forth its emissaries and plenipotentiaries, which convey its sovereign mandates, along the *voluntary nerves, to* muscles subdued to volition*.

8. Of every step of this operation the individual is perfectly conscious. Indeed, I regard the phrases—"sensation that may be felt,"—"sensation with, or without, consciousness," &c. as presenting either a repetition or a contradiction in terms, and as expressions to be discarded from physiological and medical writings. The very term sensation expresses feeling, and implies consciousness. The motions which follow a sensation, do not do so *necessarily;* a distinct act of volition, or a distinct emotion, *must* intervene, of which we are also conscious, if attentive to the operations of our own minds. The sensation, the act of volition, the emotion, may take place independently of each other: but in the first case there is no motion; in the second, the motion is *spontaneous,* and obviously *designed;* in neither, therefore, is it *necessary;* whilst, in the third, it is a movement of *expression,* sufficiently understood.

9. The acts of the soul are, as I have stated, frequently spontaneous. It is this very character of spontaneous action, indeed, which proves the soul to be free in its agency, independent of organisation (although for a time connected with it, and influenced and manifested by it), and therefore indestructible and immortal. All the acts of mere organic life are the result, the effect, of *physical* stimulus; let this stimulus cease, and its effect ceases—it is death. The functions, the operations of the soul alone are free, spontaneous,

* Galen speaks of the soul as thus seated in the cerebrum and as the source of motion:—την λογιστικην ψυχην οικειν εν εγκεφαλῳ αρχην κινησεως. De Usu Partium, l. ix. c. 4. De Loc. Aff. l. iii. c. 8.

unexcited. This is the true argument against *materialism;* but I reserve the task of unfolding it to another and more appropriate opportunity. Compare § 138.

10. It is very different in regard to the true spinal system: in this, the actions are always *excited.* The principle of motion is the *vis nervosa* of Haller, acting in modes and directions unknown to physiologists before the publication of my inquiries, the discovery of which I regard as having laid the foundation of all accurate knowledge of this system, with its extensive applications to physiology and pathology. Indeed, I may assert that the *vis nervosa,* in its *reflected* and *direct* operations, is to the nervous, what the blood, in its *circulation,* is to the vascular system; the former is the *dynamic,* the latter is the *material,* in all the corporeal functions in the animal œconomy, as distinguished from the psychical. Our knowledge of the distinct phenomena of the subdivisions of the nervous system is, further, an important guide in the diagnosis and prognosis of the *diseases* of this system; it is, to the diseases of the brain, the true spinal marrow, the nerves, and the ganglionic system, what auscultation is to those of the viscera within the thorax.

11. I repeat that the character of the functions belonging to the true spinal system is totally opposed to that of the cerebral functions already described, § 8. Dividing the motor functions of the true spinal system into the *reflex* and the *direct,* it may be affirmed that to effect the former a stimulus *must* in every instance be applied from without; the destined movement follows as *necessarily.* The influence impressed on the *vis nervosa* is conveyed, not to the cerebrum, the seat of the soul and of mind, but to the true spinal marrow, the special (but not the only) seat and centre of the *vis nervosa;* this organ excites and combines, under the influence of the same power, certain and appropriate nerves into simultaneous action,—mysteriously, and unconsciously on the part of the individual,—and a complicated but definite act, of ingestion, of egestion, of locomotion, &c. is the destined result.

12. Of all this we may be totally unconscious. The immediate cause and effect are connected necessarily. The act *may* be attended by sensation; it *may* be modified by volition; but these *mental* operations are not *essential* to the

true spinalfunctions; and, indeed, as in the trachea and bronchia, in normal respiration, in the pharynx and œsophagus, in deglutition, &c. they are frequently totally absent. The principle of action—the agent rather—is, therefore, not the mind, not the sentient soul; it is, on the contrary, proved by the clearest evidence, afforded by a series of explicit experiments, to be the *vis nervosa* of Haller.

13. I shall shortly have to relate in detail this series of experiments. They prove, by a chain of facts, that the *vis nervosa* obeys other laws than those laid down by Haller, by Bichat, by Prof. Müller, &c. I can only briefly state, in this place, that the influence of this power is seen on denuding and stimulating the spinal marrow, or a muscular nerve: the muscle or muscles, to which the nerve or nerves which have their offset *below* the point of the spinal marrow or nerve so irritated, are distributed, are immediately excited into irregular contraction. It will be observed that the motor influence, in these cases, acts in the direction *from* the point irritated *to* the muscle excited into contraction. It was denied, before the publication of my experiments, that this motor power ever acts in any other direction. A little consideration will shew that it could not, consequently, have any such physiological application as that which I have traced in regard to the functions of ingestion and egestion. *It existed as a physiological fact, without application to physiology!* My experiments have demonstrated that this *vis nervosa* does, however, in reality, act in other, incident and reflex, or centripetal or centrifugal, modes and directions, and that it is thus, in fact, the *principle of action* in the entire true spinal system,—in the experiments of Redi, Whytt, Legallois, &c.—*other facts formerly unexplained, and unapplied to physiology*, —and in all the acts of ingestion and of egestion in the animal œconomy.

14. In this system, the action of the *vis nervosa* is always and essentially *excited* in its origin, and, as I have stated, *reflex* in its direction and form. The movements of this system are therefore *never spontaneous*.

15. I am inclined to believe that the *same* principle of action, the same *vis nervosa*, exerts its power in the ganglionic system. But, in this, its operation is *direct* or *immediate*; it is also sometimes *excited*, and sometimes *continuous*.

16. The ganglionic system seems to regulate the action of all the *internal* muscular organs, of the heart, the stomach, the intestines, with nutrition, the secretions, &c.

17. But I will illustrate this subject by an experiment, to which I beg to call my readers' attention most particularly. Simple as it is, it sets forth the reality of the distinct portions of the nervous system in a manner which cannot be misunderstood.

18. *Experiment* 1.—If I take a frog and place it upon the table, I have every possible evidence of its being endowed with sensation, volition, and emotion. If I touch it, it moves, and endeavours to escape; its movements are also abundantly spontaneous; and I have the evidence of emotion in its quickened respiration.

19. *Exp.* 2.—If I divide the spinal marrow just below the occiput (see *Plate* III, *figure* 1), *all* these phenomena cease: there is no longer an attempt to escape on being touched; there are no spontaneous movements; there is no manifestation of emotion. The animal remains motionless on the table.

20. *Exp.* 3.—But certain *other* phenomena are observed: *at first*, indeed, when I prick or pinch the toes with the probe or forceps, there is no movement; but very shortly each of such excitations is followed by distinct and energetic movements, generally retractions of the limb, and the respiration continues.

21. The first of these phenomena, the *absence* of reflex actions on the application of excitants, is owing to the *shock* inflicted by the division of so vital an organ—a very important subject of investigation: as this shock gradually subsides, the movements induced by excitation are more and more energetic. They are the movements of the reflex action of the *vis nervosa* of Haller, in the true spinal marrow.

22. *Exp.* 4.—If we now divide the crural nerve (*Pl.* III, *fig.* 1) on one side, we observe that the excited *reflex* actions are destroyed, whilst the *direct* actions induced by irritation of the denuded nerve below the division, remain.

23. If we have divided the spinal marrow and the *right* sciatic nerve, we have the total absence of spontaneous movements, with reflex and direct movements, in the left extremity, on applying the appropriate stimuli to the toes and to the lower

portion of the divided spinal marrow, respectively; and direct movements *only* in the right, on irritating the lower portion of the divided nerve.

24. *Exp.* 5.—In order to display the distinct phenomena and influence of the ganglionic subdivision of the nervous system, it is necessary to proceed in a peculiar manner. Both the cerebrum and the spinal marrow may be entirely removed in a frog, by small portions at distinct intervals, without destroying the circulation in the web: this function, then, depends on, and can be impressed by, the ganglionic system *only*. There is neither cerebral nor spinal function left; there is neither cerebral nor power of reflex excited motion. If we now crush one foot, an extraordinary effect is produced: the circulation in the other is instantly and completely arrested! This effect can only have been produced through the ganglionic portion of the nervous system; and I think this is the only published experiment of the kind.

25. In the edition of this work published in the form of "Lectures," in 1836, I expressed myself in the following manner:—

26. 'You observe this living frog: its sentient and voluntary functions are obvious. I divide the spinal marrow, below the occiput, with these scissors: all is still. There is not a trace of *spontaneous* motion. The animal would remain in this very form and position, without change, until *all* signs of vitality were extinct. But now I pinch a toe with the forceps. You see how both posterior extremities are moved. All is now still again; there is no spontaneous motion, no *sign of pain* from the wound made in the neck. It is without sensibility—without volition; the *power* to move remains—the *will* is extinct. I now pinch the integument. You observe the result—the immediate recurrence of excito-motory phenomena.

27. 'I now destroy the whole spinal marrow with this probe. It is in vain that I pinch the toes; the animal, the limbs are motionless!

28. 'Could the former *excited* motions be those of irritability? I will try the truth of this suggestion by seeing whether, now that the axis of the excito-motory system is destroyed, with its phenomena, the application of a slight

galvanic shock will prove the subsistence of irritability. You see how instantaneously and forcibly the muscles are stimulated to contraction.

29. 'Is not the proof, from these experiments, of the distinction between the motions of volition, of the excito-motory system, and of these from those of irritability, perfectly and unequivocally complete?'

30. We have thus isolated, in an experiment which any one may repeat, the phenomena of the cerebral, the true spinal, and the ganglionic subdivisions of the nervous system. It is unnecessary to add, that the principles so disclosed are applicable in our investigations into the physiology of other animals, and to the physiology and pathology of man.

31. But that it may not be imagined that these distinct phenomena of the distinct parts of the nervous system are confined to the lower orders of animals, I here adduce another experiment, not less interesting, upon the horse.

32. *Exp.* 6.—A horse was struck with the poll-axe over the anterior lobes of the brain. It fell instantly, as if struck with a thunder-bolt; it was convulsed, and then remained motionless. It shortly began to breathe, and continued to breathe freely by the diaphragm.

33. When lacerated or pricked by a sharp or pointed instrument, as a *pin* or a *nail*, on any part of the face or surface of the body, it was totally motionless, manifesting no evidence of sensation or volition.

34. When, on the other hand, the *eye-lash* was touched with a *straw*, the eye-lid was forcibly closed by the action of the *orbicularis*. When the cornea was touched, the eye-ball revolved outward by the action of the *abducens*. When the verge of the anus was touched, the *sphincter* contracted forcibly, the tail was raised, the vulva was drawn towards the anus.

35. The upper part of the medulla oblongata was now destroyed by an instrument passed through the orifice made by the poll-axe: there were violent convulsions; the respiration ceased, and the eye-lid and eye-ball remained motionless on the application of stimuli.

36. Now, I imagine that it will not be disputed, that the blow of the poll-axe, in this case, annihilated the cerebral or

sentient and voluntary functions; and that a peculiar set of excito-motory phenomena remained. Deep lacerations produced no evidence of the former; the touch of a straw induced a full manifestation of the latter. The destruction of the medulla oblongata removed all trace of excito-motory phenomena in the eye-lid and eye-ball.

37. As in the experiment on the frog, the first effect of the blow is that of *shock*. It has been observed, that if the blow of the poll-axe which fells the bullock be not immediately followed by the destruction of the spinal marrow (which is accomplished by the introduction of a cane), the poor animal, in some instances, begins to move, after a time, and would eventually regain his feet. The *first* effect of cerebral laceration and hæmorrhage is of the same character—a fact of extreme importance, as we shall see hereafter, in the earliest part of the treatment of hemiplegia.

38. Nor are these phenomena confined even to experiments, or to animals of the highest rank in the zoological series. They are equally observable in the human subject, and are of the utmost value in a diagnostic point of view.

39. *Case* 1. I have this day (January 3, 1841) seen, with Mr. Duffin, a case of the most complete hemiplegia of sensation and volition, of the *left* side, without loss of intellect, and with the perfect continuance of all the reflex actions: respiration, deglutition, the action of the sphincter ani, are unimpaired; and the following distinct reflex actions and phenomena were observed:

40. 1. On tickling the *left* side of the cheek, the patient complained, and the left shoulder was forcibly agitated.

41. 2. On tickling the palm of the *left* hand, the arm and fingers were moved, but without consciousness.

42. 3. On tickling the sole of the *left* foot, the extensors of the toes, and especially of the great toe, were strongly contracted; still without consciousness. The same effect was produced by applying a metallic spoon just taken out of cold, and of hot water: the extensors of the toes retained their contracted condition, whilst our visit lasted. It was the third day of the disease. The general symptoms were unchanged from the beginning, as far as they had been observed.

43. *Case* 2. I saw a precisely similar case some years ago,

with Mr. Doubleday, of Blackfriars' Road. Perfect hemiplegia coincided with an unimpaired state of the reflex actions and functions,—of the respiration, deglutition, the sphincters, the expulsors.

44. The cerebral system is separated from the true spinal, in hemiplegia, as frankly as in our best-devised experiments.

45. Having thus, then, briefly and cursorily noticed the subdivisions of the nervous system, so essential to the investigation of its diseases, I must now observe, that my attention has recently been specially directed to the application of these views to pathology and practice*. If we would convince ourselves of the real practical value of these views at the bedside of the patient, we have only to observe, with care, a few actual cases of disease of the nervous system:

46. In the most familiar case of hydrocephalus, or of hydrocephaloid disease, the progress of the case towards a fatal or favourable issue is most accurately and indeed beautifully traced by observing the presence, increase, or decline, of symptoms of affection of the true spinal and ganglionic systems.

47. In the ordinary fit of apoplexy, the prognosis is favourable or unfavourable, according as the symptoms are limited to affections of the cerebral system, or are extended to the true spinal and ganglionic.

48. In the case of exhaustion, the state of irretrievable sinking is denoted by the supervention of impaired cerebral, true spinal, and ganglionic symptoms; and there are respectively, dozing, catching inspirations, dysphagia, and bronchial crepitus, and a tympanitic state of the intestines.

49. Convulsions are, in the first instance, affections of the true spinal system; but they speedily involve the cerebral, and eventually the ganglionic system.

50. Nothing can be more interesting than to observe and trace the changes to which I have adverted, and to deduce from them the diagnosis and prognosis, and the effects of remedies. In one case of the deep coma of epilepsy, I touched the border of the eye-lid, and dashed cold water on

* See my "Memoirs on some Principles of Pathology in the Nervous System;" in the Transactions of the Royal Medical and Chirurgical Society, for 1839 and 1840.

the face, without producing the slightest effect; we then took an ample quantity of blood from the arm, and immediately the same impressions induced closure of the eye-lids, and a sobbing inspiration! Every visit to the sick-room, or the wards of an hospital, now affords us the opportunity of applying these principles, these distinctions, to the diagnosis and prognosis of diseases of the nervous system; and observations upon this subject now obtain a place in almost every *clinical* lecture.

51. I need not, therefore, further expatiate on the real and practical value of these phenomena. But I must take this early opportunity of impressing my readers' minds, that, to become good and enlightened practitioners, we *must* become able physiologists.

52. I have endeavoured to pursue this inquiry through the medium of anatomy, physiology, and pathology; whilst my aim has also continually been to investigate the effects of remedies and to improve the practice. I think that the science and art of medicine are by no means incompatible acquirements, and that the boast of being a mere practitioner should cease to be a cloak for ignorance and indolence. To pretend to understand the diseases of the nervous system without an intimate knowledge of its anatomy, physiology, and pathology, is, indeed, the height of folly or presumption. The symptoms of these diseases can be justly interpreted by the anatomist, the physiologist, alone; and an accurate knowledge of the symptoms is absolutely necessary to practice: it is the principal source of the diagnosis, and our constant guide in the administration of remedies.

53. Nor is a knowledge of the structure and functions, the anatomy and physiology, of the nervous system, sufficient alone for the full comprehension of the diseases of this system. The nervous system does not exercise its functions uninfluenced by the other systems of the animal economy, or by the general system as a whole. The reciprocal influence of these, and the nervous system, must be clearly understood before our view of the subject can be said to be satisfactory.

54. Indeed, the entire economy of the human frame, although constituted by various systems, is one and indivisible; and it is impossible that one of those systems should

be morbidly affected without the participation of the rest. In order to accommodate this difficult and complicated subject to our limited understanding, it has been found necessary, however, in the pursuit of medical science, to proceed analytically, and to imagine the different systems of which the whole animal œconomy is composed, to be separated so as to admit of distinct examination; and we speak of the nervous, the circulatory, the respiratory, the digestive, the urinary, the uterine systems, &c. as distinct objects of inquiry. We are compelled, however, afterwards, to review the subject synthetically, and to consider the influences of one or more of these systems, or of the general system, upon the other systems, respectively. Of the last kind of influence, is that observed in the sudden effects of mental shock, especially *fright;* in the more gradual effects of mental harass, as *grief, anxiety,* &c.; in the effects of *loss of blood,* in *chlorosis,* in *arthritis:* in the morbid conditions of the *digestive organs,* of the *kidneys,* &c.

55. There is one other subject which must occupy our attention. It is the effects of sexual excesses and vices, with their effects in nervous, vascular, and spinal excitement and exhaustion—a delicate and repulsive subject, yet one of the utmost importance; and doubly interesting to me, from its immediate relation to the principal subject of this volume. As the normal acts of the generative system, in both sexes, are acts of the true spinal marrow, in connection with its incident and reflex nerves, so the abnormal acts of that system, may frequently be illustrated by our knowledge of morbid reflex actions. We learn to appreciate the influence of hæmorrhoids, of fissure, of ascarides, of diseased prostate, in inducing emissions of the semen without any act of sensation or volition, but with most baneful effects on the special system of the generative and urinary organs, and on the general system.

56. To this subject belong impotence and sterility, and certain of the imperfections of the parturient process.

57. I proceed to treat in this manner of the nervous system; or of that system by means of which we are connected, through sensation, perception, judgment, volition, and voluntary motion, with the external world; of that system by means

of which the *ingesta* and *egesta* of the animal economy are regulated; and of that system by the agency of which, out of the ingesta, the various organs, limbs, &c. are formed and nourished.

58. The first objects which will occupy us will be the anatomy and physiology of the nervous system: we shall then consider its pathology. This will naturally lead us to consider the individual diseases to which this system is liable. We shall then trace the influence of morbid states of the other systems taken individually, and of the general system, upon the nervous system. This plan will be pursued both in regard to the *infant* and the *adult.*

59. Before I conclude this very cursory view of the subject of this division of the nervous system, I must briefly advert to two interesting points. The first is the influence of *emotion,* the *physical instincts,* the *appetites,* the *passions,* &c. the second, the source of the *tone* and of the *irritability* of the muscular system. The former, though connected with the mind, acts through the true spinal and ganglionic systems; the latter seems to reside in these systems.

60. I must also advert, equally briefly, to a most interesting phenomenon of the nervous system—that of *sleep.* Deep and quiet sleep greatly removes the influence of the cerebral system, leaving the true spinal and the ganglonic in full action. The subject is of deep interest both to the physiologist and the pathologist. Not less so is that singular affection of the nervous system much allied to sleep, and repaired by sleep, termed *fatigue.* Both sleep and fatigue are affections of the cerebral system, and only remotely connected with the true spinal and the ganglionic.

61. I shall proceed to treat of each of these subjects distinctly; and I shall then point out the application of these distinctions in the nervous system, of the anatomy, physiology, pathology, and therapeutics, to the *diagnosis* and *treatment* of the *diseases of the nervous system.* Indeed, I think that no branch of Medical Science more beautifully illustrates that *Connection between Anatomy, Physiology, Pathology, and Therapeutics,* on which I have so much and so repeatedly insisted, than that of the Nervous System. I shall have repeated opportunities of reverting to that connection, and of pointing out

the interest and importance attached to it, in reference to *the Practice of Medicine.* On some future occasion, I hope to be enabled to treat this subject distinctly.

62. In these *outlines,*—and what I now publish, *are* merely outlines of a vast subject,—I shall endeavour, whilst I do not hesitate to repeat important points, not to write an unnecessary paragraph, or indeed an unnecessary word. My object is to convey to my younger readers the materials for thinking, and to excite habits of reflection.

63. I conclude with the following tabular view of the principal subjects of this section, which I beg my reader to compare carefully with *Plate* I, *figure* 1, and *Plate* II, *fig.* 2 and 3. With these the mind of the student should be made perfectly familiar. Each of the divisions of the nervous system should be considered *distinctly ;* they should then be viewed as *superimposed* upon each other, so constituting the entire nervous system. The whole may then be viewed as representing the system of *Neurodynamics,* to which, if we add that of *Hæmodynamics,* we have a pretty complete view of *Physiology.* There is, indeed, one other department, important enough to form a third subdivision of physiology; viz. that of the muscular system and its properties, or *Myodynamics.* It is almost universal in the animal frame, and intimately associated with the other two. These three subjects, taken in their connections with Anatomy and Pathology, as expressed in § 60, present us with the *Theory* of Medicine, to which the Therapeutics, or the action of Remedies and Poisons, must be further added, to give us the *Practice.*

64. Medicine seems the last of the sciences to be emancipated from empiricism. I remember the time when a physician who thought, and investigated, was branded with being theoretical; and even now it is the boast of some, incapable of thinking, that, for their parts, they are practical men! But medicine will eventually follow the examples of astronomy and of chemistry, and physicians will eventually imitate Newton and Dalton. Observation and theory will be associated, and he will come to be the best practitioner, who both observes and reasons best.

TABLE OF THE NERVOUS SYSTEM.

I. *The entire Nervous System is divisible into*

I. *The Cerebral.*
II. *The True-Spinal.*
III. *The Ganglionic.*

II. *The Cerebral System is*

I. *The Seat of the ψυχη, or soul, and*
II. *The system of*
1. *Sensation and of the Senses.*
2. *Volition and of Spontaneous Motion.*
3. *Sleep and Fatigue.*

III. *The True Spinal System.*

I. *The Principle of Action is the Vis Nervosa.*
II. *Its Modes of Action are excited and reflex or direct.*
III. *The Reflex Functions are those of*
1. *Ingestion and Retention.*
2. *Egestion and Exclusion.*
IV. *The Direct Functions are*
1. *The Tone* } *of the Muscular*
2. *The Irritability* } *Fibre.*

IV. *The Ganglionic System.*

I. *The Principle of Action is the Vis Nervosa.*
II. *The Mode of Action excited, direct or immediate.*
III. *The Functions those of*
1. *The Internal Muscular Organs,*
1. *The Heart and Arteries.*
2. *The Stomach and Intestines.*
2. *Nutrition.*
3. *Secretion, &c.*

V. *The System of the Emotions; these are*

I. *Psychical Affections, acting through*
II. *The True Spinal, and*
III. *The Ganglionic Systems.*

Mixed Functions.

Mixed, in the Œsophagus; the Rectum?

CHAPTER I.

THE CEREBRAL, OR SENTIENT AND VOLUNTARY SYSTEM.

65. In treating distinctly of the three grand divisions of the nervous system, the cerebral, the true spinal, and the ganglionic, I shall adopt the following order:

1. *The Anatomy.*
2. *The Principle of Action.*
3. *The Physiology.*
4. *The Pathology.*
5. *The Therapeutics.*

In this manner I now proceed to treat of the Cerebral, or Sentient and Voluntary System.

Section I.—*The Anatomy of the Cerebral System.*

66. I have already observed, that the designation, *cerebro-spinal,* is incorrect. It comprises *two* subdivisions of the nervous system, which must be distinguished from each other, and of which the *cerebrum* and the *true spinal marrow* are the respective centres or axes.

67. The first, or the *cerebral* system, comprises every part of the nervous system which relates to *sensation* and *volition,* the nerves of *sense*—the olfactory, the optic, the auditory, the gustatory, the nerves of touch, and the whole of the nerves of voluntary motion. Its centre is the cerebrum, including the cerebellum; its sentient nerves run variously from the organs of sense, and from the *external* surfaces, first *without* the cranium or spine, and then *within* the cranium or spine, *to* that centre; its voluntary nerves pursue a similar but retrograde course *from* that centre to the muscles of voluntary motion.

68. In speaking of the cerebral subdivision of the nervous system, I shall particularly notice the subjects of the subjoined *Table*:—

TABLE OF THE CEREBRAL SYSTEM.

I. The Membranes.
   1. *Of the Summit;*
   2. *Of the Base.*

II. The Cerebrum, and its principal divisions, viz.
   1. *The Cortical Substance.*
   2. *The Medullary Substance.*
   3. *The Hemispheres.*
   4. *The Anterior Lobes.*
   5. *The Corpora Striata.*
   6. *The Thalami.*
   7. *The Tuber Annulare.*

III. The Cerebellum.
   1. *The Middle Lobe.*
   2. *The Lateral Lobes.*

IV. The Cerebral Nerves.
   I. *The Sentient.*
      1. *The First,* or *Olfactory.*
      2. *The Second,* or *Optic.*
      3. *The Fifth,* or *Trifacial.*
      4. *The Eighth*,* or *Auditory.*
      5. *The Ninth,* the *Glosso-pharyngeal,* or *Gustatory (?)*†.
      6. *The Posterior Spinal,*—
   II. *The Voluntary,*
      1. *The Third,* or *Oculo-motory,*
      2. *The Minor position of the Fifth,* or *Masticatory.*
      3. *The Twelfth,* or *Myo-glossal.*
      4. *The Anterior Spinal,*—
         1. In their course *within* the Cranium,
         2. In their course *without* the Cranium,
         3. In their course *within* the Spine, usually viewed as the SPINAL MARROW,
         4. In their course *without* the Spine.

* In my account of the Nerves, I follow the enumeration of Sœmmering and of Prof. Arnold, as being the freest from hypothesis:

1. *The First is the Olfactory.*
2. *The Second, the Optic.*
3. *The Third, the Oculo-motory.*
4. *The Fourth, the Trochlearis Oculi, or Patheticus.*
5. *The Fifth, the Trifacial.*
6. *The Sixth, the Abducens Oculi.*
7. *The Seventh, the Facial, or Portio dura.*
8. *The Eighth, the Auditory, or Portio mollis.*
9. *The Ninth, the Glosso-pharyngeal.*
10. *The Tenth, the Pneumo-gastric.*
11. *The Eleventh, the Spinal Accessory.*
12. *The Twelfth, the Myo- or Hypo-glossal.*

† Professor Panizza; see the Edinb. Med. and Surg. Jour. vol. xiv. p. 70.

69. With this Table, I beg my readers to compare *Plate* II, *fig.* 1.

70. The cerebro-spinal subdivision of the nervous system, or, as it would be more correctly designated, the cerebral, is the system of *sensation* and *volition*. It is the system by which we are connected *intellectually* with the external world. It is that by means of which we feel and perceive external objects, and by which we approach them and appropriate them to our use exteriorly. My fingers being in contact with any object of moderate size, I feel, I perceive it, and, by an act of volition, I raise it from the table. This apparently simple operation requires *three* portions of anatomy.

71. 1. Certain nerves must proceed continuously, uninterruptedly, *from* the points of my fingers *to* the cerebrum, the centre of this system:

72. 2. The cerebrum must be in a state of integrity; and,

73. 3. Certain nerves must proceed *from* the cerebrum *to* the muscles which are to be called into action.

74. There are, then, *two* sets of cerebral nerves; at least there are cerebral nerves having *two functions*. This was distinctly known to Galen. To anatomists it has long been known that the *fifth* cerebral nerve, or the *trifacial*, and *each* spinal nerve, has *two roots*.

75. It had also been universally known that these nerves were nerves of *sensation* and nerves of *motion*. The splendid idea*, that as each of these nerves has two roots, and two functions, one of these roots might serve for sensation, and the other for motion, seems first to have occurred to Mr. Walker. This gentleman observes, in the "Archives of Universal Science," for July 1809, published in Edinburgh, p. 172—"medullary action commences in the organs of sense, passes to the spinal marrow by the anterior fasciculi of the spinal nerves, which are, therefore, nerves of sensation—ascends through the anterior columns of the spinal marrow," &c. and—"it descends through the posterior columns of the

* "Confining myself, then, to the discovery of the distinction of sensitive and motive nerves, I must remark that, according to the mode in which I have viewed all such events, the discovery consisted of two parts: the conception, or *idea*, and the confirmation of this by *facts*. I shall speak of these in succession."—Whewell's Letter in the Medical Gazette, for 1837-8.

spinal marrow, which are therefore its descending columns, and expands through posterior fasciculi of all the nerves, which are therefore nerves of volition," &c. and — "as, in some cases, sensation exists without volition, and as almost all nerves arise by distinct filaments, I am of opinion that whenever a part, having both sensation and volition, is supplied from one nervous trunk, that trunk envelopes both a nerve of sensation and one of volition," &c. That these paragraphs are remarkable, no one can deny. They involve in the most explicit terms, the idea of double function with the double origin and root of the spinal nerves; but they also, I believe, involve the error of mistaking the sentient for the motor root, and vice versa. To Sir Charles Bell belongs the merit of having prosecuted the subject, of having submitted the *idea* to the test of *experiment*, and of having discovered the true view of the subject. He observes, in his "Idea of a new Anatomy of the Brain," in 1821—"In thinking of this subject, it is natural to expect that we should be able to put the matter to proof by experiment."

76. "I found that injury done to the anterior portion of the spinal marrow, convulsed the animal more certainly than injury done to the posterior portion; but I found it difficult to make the experiment without injuring both portions.

77. "Next, considering that the spinal nerves have a double root, and being of opinion that the properties of the nerves are derived from their connection with the parts of the brain, I thought that I had an opportunity of putting my opinion to the test of experiment, and of proving at the same time that nerves of different endowments were in the same cord, and held together by the same sheath.

78. "On laying bare the roots of the spinal nerves, I found that I could cut across the posterior fasciculus of nerves, which took its origin from the posterior portion of the spinal marrow, without convulsing the muscles of the back; but that on touching the anterior fasciculus with the point of a knife, the muscles of the back were immediately convulsed. Such were my reasons for concluding that the cerebrum and the cerebellum were parts distinct in function, and that every nerve possessing a double function, obtained that by having a double root."

79. I have thus given a succinct account of the origin of this "second discovery in physiology" in the words of their authors. Mr. Walker had decidedly the first idea of the distinct functions of the anterior and posterior roots of the spinal nerves and columns of the spinal marrow; but he reasoned only, and reasoned amiss, and was led to an erroneous conclusion. Sir Charles Bell, on the contrary, proceeded to experiment, and arrived at just results.

80. To Mr. Shaw, the brother-in-law, and to Mr. Mayo, the former pupil, of Sir Charles Bell; to Signor Bellengeri in Italy, and to M. Magendie in France, the investigation of this physiological principle is greatly indebted: it has been completed by Prof. Müller of Berlin.

81. I shall not attempt, at present, to determine the precise degree of merit of each of these physiologists. *None* can rank as a discoverer, in the sense in which I affix that elevated title upon Sir Charles Bell; whereas *all* possess the merit of *pursuing* an inquiry which that distinguished physiologist *originated*. Nevertheless, truth compels me to state, that Sir Charles Bell's experiments were defective, and his proof of his own doctrine deficient. He observes, "After delaying long an account of the unpleasant nature of the operation, I opened the spinal canal of a rabbit, and cut the posterior roots of the nerves of the lower extremity. The creature still crawled; but I was deterred from repeating the experiment by the protracted cruelty of the dissection. I reflected, that an experiment would be satisfactory if done on an animal recently knocked down, and insensible; that whilst I experimented on a living animal, there might be a trembling or action excited in the muscles by touching a sensitive nerve, which motion it would be difficult to distinguish from that produced more immediately through the influence of the motor nerves. A rabbit was struck behind the ear, so as to deprive it of sensibility by the concussion, and then I exposed the spinal marrow. On irritating the posterior roots of the nerve, I could perceive no motion consequent in any part of the muscular frame; but on irritating the anterior roots of the nerve, at each touch of the forceps there was a corresponding motion of the muscles to which the nerve was distributed. Every touch of the probe, or needle, on the threads

of this root, was attended with a muscular motion as distinct as the motion produced by touching the keys of a harpsichord. These experiments satisfied me that the different roots, and different columns from whence these roots arose, were devoted to distinct offices, and that the notions drawn from the anatomy were correct*."

82. In these experiments, a distinction is not made between *excited* and *voluntary* motion. It was proved that the *anterior* roots of the spinal nerves were endowed with a power of *exciting* motion. It still remained to be ascertained whether they were *also* conductors of volition. This was accomplished by Prof. Müller, whose results have been confirmed by Sig. Panizzi.

83. Prof. Müller observes:—"If we divide in the same frog all the three posterior roots of the inferior extremities on the left side, and all the three anterior roots of the nerves on the right side, sensation in the left leg and motion in the right leg are destroyed. If we then cut off the foot from the right leg, which retains sensation, but not motion, the frog manifests, by motion in all parts of its body, the utmost pain; but the right leg, which is the seat of pain, is immoveable. If, on the contrary, we cut off the foot from the left leg, which retains the power of motion, but no sensation, there is total insensibility. This experiment is the most surprising of all, and affords decided, not uncertain, results; because, in the frog, we may cut wholly through the roots of the inferior extremities, the roots being very few, but thick.

84. "These experiments place beyond all doubt the truth of Bell's doctrine†."

85. Thus, then, the proof of the doctrine of Sir Charles Bell, the *second* discovery in physiology, according to Prof. Müller, is complete.

86. With the posterior and anterior roots of the trifacial and spinal nerves, Sir Charles Bell associates the posterior and anterior *columns* of the spinal marrow, as being sentient and voluntary respectively. This doctrine wants the full proof afforded to that of the distinct functions of the two roots of the nerves by the experiments of Professor Müller.

* Nervous System, 1830, Preface, p. vii, &c.

† Handbuch der Physiologie, p. 629.

87. The abdominal nervous columns in the *articulata* have been generally regarded as analogous with what has been designated the cerebro-spinal axis of vertebrated animals. Lyonet and Treviranus had partially traced the *third*, or more central and aganglionic column, passing *over* the ganglia of the two peripheral columns; but to Professor Müller is due the merit of having first *traced* and *figured* the third column passing over the upper surface of the ganglia (in the scorpion) in the entire length of the nervous system; and to Professor Grant that of having first distinctly assigned (in his lectures in 1832) to this column its special *motor* function.

88. This latter fact has been certified to me by a pupil who attended Prof. Grant's lectures in that year, and who favored me with a copy of his notes. The doctrine has, I am sorry to say, been very discreditably and ungratefully published by another pupil, without acknowledgment of the source from whence it was derived. The matter is of the more consequence because that which Prof. Grant deduced from analogy and reasoning has been confirmed by experiment.

89. I took a lobster and laid bare the nervous columns.

90. I first stimulated one of the aganglionic nerves. The muscles to which it was distributed, and *they alone*, were contracted.

91. I then stimulated a ganglionic nerve. Muscles, both *anterior* and *posterior* to the part stimulated, were excited into combined action.

92. The same event occurred when I stimulated a part of the general or combined nervous column itself.

93. From these experiments we may conclude—

94. 1. That the aganglionic nerves are the voluntary or motor nerves.

95. 2. That the ganglia or general columns are the centres of the incident and reflex nerves, and of the reflex actions.

96. It remains to be ascertained whether the *sentient* nerves belong to the *ganglionic* columns; but this seems most probable.

97. I have thus detailed, in as plain terms as possible

the present state of our knowledge of the *cerebral* division of the nervous system. It comprehends,

98. I. Sentient nerves, leading to the posterior roots of the trifacial and spinal nerves, and the posterior columns of the spinal marrow.

99. II. The cerebrum, the centre of the system.

100. III. The voluntary nerves issuing from the anterior columns of the spinal marrow and the anterior roots of the trifacial and spinal nerves.

101. A sketch of the cerebral system is given in *Plate* II, *fig.* 1.

102. The *lines* which are bracketed with the sketch of the system, are intended to denote the course and ultimate destination of these two sets of nerves, and will be found especially interesting when contrasted with similar lines denoting the operation of another principle,—another system. The ascending lines denote the sentient, the descending the voluntary nerves. They decussate with those of the opposite side, in the medulla oblongata, as represented by the curve at their upper part.

103. From this diagram all but the senses and the limbs are excluded. Not that the cerebrum exerts no influence over some of the other organs,—as the orifices, the sphincters, the organs of ingestion and of egestion; but these are principally actuated by the true spinal marrow, and are only partially under the influence of volition. After having described the spinal system, it will be necessary to revert to this point, under the head of the *mixed* functions. It will be seen that the cerebral and true spinal systems modify each other mutually in the perfect animal.

104. I have only briefly to remark upon this arrangement of the cerebral nerves, that it must be viewed as *combined,* in the living animal, with the system of true spinal nerves to be given in a future page; that every such compound sentient and excitor, and voluntary and motor, nerve, must be presumed, physiologically speaking, to have *two connections, one cerebral, the other spinal,* with sentient and excitor *origins* in cutaneous and mucous surfaces, and appropriate *destinations* in the muscular system.

Section II.—*The Physiology of the Cerebral System.*

105. I shall be brief in my observations on the physiology of the cerebral system; and my object, in the observations which I do make, will be principally to point out the perfect distinctness of this and the true spinal system.

106. The physiology of the cerebral system comprises sensation in all its forms, perception, judgment, volition, and voluntary motion.

107. The senses, I need scarcely say, are the smell, the sight, the hearing, the taste, the touch; they convey to the mind all that we know of the external world. Perception is derived from these. Judgment is a purely mental act. So is volition; and of this, voluntary motion is a frequent result. The motions which result from sensation generally *imply volition;* but as volition may exist without any previous sensation, the voluntary motions frequently are, and *may be* at any time, *spontaneous*, as I have already stated, § 7.

108. It is almost unnecessary to advert to the series of operations in what appears to be the very simple process of voluntary motion consequent on sensation. I may, however, briefly state that that sensation, or some effect of the impression which produces it, must be conveyed by an appropriate nerve uninterruptedly to the cerebrum,—to the ψυχη; and that thence the act of volition must act through a voluntary nerve, equally uninterrupted in its course, from the cerebrum to the muscle or muscles to be moved.

109. Thus we have a nervous arch, of which the cerebrum is the key-stone. Such arches are displayed in the *Table*, at p. 17—18, and in *Plate* II, *fig.* 1.

110. There is an *affection* of the mind to which I have briefly adverted above; viz. *emotion;* and this may be excited by a *sensation:* it may also immediately issue in *motion*. But there is this great distinction between the motions which follow emotion and those which are induced by acts of volition: the former, unlike the latter, act upon the true spinal marrow, and the ganglionic nerves and muscles. Thus a disgusting object placed before the eyes will induce vomiting and fainting. No subject is more interesting to the physiologist or the

physician. I know of no diseases which are more formidable than those, for example, which have been induced by fright, by surprise, by anxiety, by grief! Epilepsy, mania, sinking, icterus, dropsy, have had such an origin!

111. It is obvious, then, that a sensation may lead to an act of volition, or an action of emotion. These must be carefully distinguished.

112. The distinctive character of voluntary motion is its spontaneous occurrenee. Without sensation, without emotion, the individual *wills*, and a voluntary movement succeeds.

113. Volition has a continued effect upon some functions which depend upon another system, the nature and phenomena of which should be well understood. One of these functions is respiration. Excito-motory in general, respiration is constantly modulated as it were by volition. Let us observe the effect of withdrawing the participation of volition in respiration: this occurs during sleep; and the respiration becomes unequal, irregular, stertorous. The same thing occurs during intense attention. I have observed that, in the mathematician during the solution of a problem, and in the engraver whilst engaged in performing some nice and delicate work, the respiration becomes affected in a similar manner.

114. The subject of *sleep* is also one of deep interest. This state involves the diminution, not the cessation, of the mental functions. Sensation, perception, attention, volition, are at their minimum. Respiration and the other *mixed* functions are also impaired. And I believe this to be a principal reason why some diseases of the nervous system, as the crowing disease or laryngal asthma in infants, and the bronchial asthma in adults, frequently occur during the first sleep. In the *erethismus mercurialis*, the respiration during sleep becomes so impaired as to threaten dissolution. My reader may consult the interesting case of the late Dr. Bateman*. A similar effect of sleep is observed also in disease of the heart, and in the reaction (another form of erethismus) from loss of blood.

115. Sleep is an affection of the cerebral system. It is *its* repose. The true spinal system, and the ganglionic

* See the Medico-Chirurgical Transactions, vol. ix, p. 226.

system, never sleep. They only feel the *effect* of sleep in removing the participating agency of volition in some of the excito-motory acts, and especially in that of the respiration.

116. Another function of the cerebral system is the sense of *fatigue*. How nearly allied this condition is to its "sweet restorer, balmy sleep," I need not mention. As the true spinal system does not sleep, so it is incapable of fatigue; and it is on this principle, I believe, not only that respiration is unattended by fatigue (except in cases of dyspnœa, or otherwise, when our *attention* is particularly directed to it, and it becomes greatly a voluntary act), but that the long flight of birds in their migrations, and of flies which are all the day long on the wing, is sustained. That this flight is greatly excito-motory, like respiration, is proved by experiments on beheaded birds and insects, which cannot be detailed in this place.

117. The character of voluntary motions is that of being frequently spontaneous. It is by this character that the motions which belong to the sentient and voluntary system are distinguished from those which belong to the excito-motory: these are never spontaneous; they are *always excited*. Even the motions of respiration, as far as they belong to this system, are excited motions, as I shall show immediately. Legallois, M. Flourens, Sir Charles Bell, are equally in error, I think, when they consider the medulla oblongata as the *source*, the *primum mobile*, of the respiratory motions: it is the *channel* through which the excitors act, and the organ which *combines* the different movements which constitute the acts of respiration; but the true *source* of these movements is in certain excitor nerves,—the excitors of respiration,—and principally branches of the pneumo-gastric, but also of the fifth and spinal nerves. Equally remote from the truth, I think, is the opinion of Dr. Philip and Mr. Mayo, that the acts of the respiration are entirely voluntary. This is, in fact, a mixed function, as *all*, or nearly all, the acts of the excito-motory system may be; and although generally belonging to the excito-motory system, yet capable of being affected through the medium of volition. This subject will be pursued hereafter.

118. A point which belongs more immediately to our

present subject,—the cerebral system,—is that of the influence of the senses over the acts of volition. There is a case of anæsthesia, published by Dr. Yelloly, in the Transactions of the Medico-Chirurgical Society, vol. iii, p. 99. The patient could hold a cup in her hand securely, if she kept her eyes fixed upon it; but if she ceased to look at it, it fell to the ground. I have this day seen a patient with a slight degree of paralysis of feeling and of voluntary motion in his lower limbs. He walks safely whilst his eyes are fixed upon the ground, but stumbles immediately if he attempts to walk in the dark. His own words are, " my feet are numb; I cannot tell in the dark where they are, and I cannot poise myself." The voluntary motions are regulated by the sense of touch, when this is unimpaired; or by that of sight, when the the touch is paralysed.

119. Many attempts have been made to *localize* the functions of the cerebrum; that is, to prove certain functions to be attached to certain parts of that organ; without, however, much success. The facts supplied by pathology certainly lead us to the conclusion that the hemispheres of the cerebrum and cerebellum regulate the *voluntary* movements of the *opposite* side of the body; whilst the medulla oblongata and spinalis *convey* the influence of stimuli to the *corresponding* side. It has been asserted, from similar facts, that the anterior lobes of the brain govern the speech; the corpora striata, the inferior extremities; and the thalami, the superior extremities: but I fear these deductions are not sufficiently substantiated. The same remark must be made relative to the supposed connection between the cortical portion of the cerebrum and the intellectual faculties, and the cineritious portion, and the movements. I shall revert to these opinions immediately.

Section III.—*The Pathology of the Cerebral System.*

120. The cerebral system being the system of the sensations, of judgment, of volition, it is to it that we must refer all morbid conditions of these mental acts or functions. Every derangement of the senses, every form of delirium or

of coma, or of perverted imagination or judgment, every *act* of violence, must be referred to the condition, primary or secondary, of the cerebrum or cerebellum.

121. The facts which, in a *practical* point of view, are the most important, are those determined by M. Magendie and M. Flourens,—that it is impossible, by lacerations or other modes of injury of the *cerebrum* or *cerebellum*, to induce either pain, or contraction in the muscular system. These organs are not endued with *sensibility*, or with the *vis nervosa* of Haller. They are the seat of a self-acting, automatic, sentient and motive principle—the ψυχη, or soul; but they are *themselves* incapable either of sensation, or of the production of motion.

122. M. Magendie observes—" Examiné sur l'animal vivant, le cerveau présente des propriétés remarquables, et bien éloignées de ce que l'imagination pourrait nous représenter. Qui croirait, par exemple, que la plus grande partie des hémisphères, sinon la totalité, est insensible aux piqûres, déchiremens, sections, et même aux cauterisations? C'est pourtant un fait sur lequel l'expérience ne laisse aucun doute."

123. " Les lésions de la surface du cervelet montrent aussi que cet organe n'est point sensible*."

124. M. Flourens observes, as the conclusion of his experiments, " Ainsi, 1° les hémisphères cérébraux ne sont point susceptibles d'exciter immédiament des contractions musculaires.

125. " Haller et Zinn† l'avaient déjà reconnu pour les parties supérieures; Lorry‡ pour le corps calleux: je l'ai vérifié pour tout l'ensemble des hémisphères, les corps striés et les couches optiques.

126. " C'est à tort qu'on a attribué la paralysie des iris à la lésion de ces dernières parties. On peut les couper, ou les piquer sur tous les points, sans abolir comme sans provoquer la contractilité des iris.

127. " Quelques observateurs ont cru exciter des contractions et des convulsions, dans les mammifères, par les

* Précis de Physiologie, 1836, t. i, p. 236.

† " Mémoires sur la Nature sensible et irritable des Parties du Corps animal; Lausanne, 1756; t. i—ii.

‡ " Acad. des Sciences, Mém. des savans étrangers, t. iii.

piqûres du corps calleux ; c'est que ces piqûres s'étendaient jusqu'aux tubercules quadrijumeaux.

128. " 2° Le cervelet n'excite point non plus immédiatement des contractions musculaires.

129. " Haller et Zinn se sont trompés, quand ils ont dit que les blessures du cervelet causent des convulsions universelles : cela n'est vrai que de la moelle alongée placée audessous de lui, et probablement intéressée dans leurs expériences.

130. " 3° Les tubercules quadrijumeaux excitent des convulsions.

131. " Leur irritation, comme elle des nerfs optiques, provoque les contractions de l'iris. C'est avec ces tubercules que commence ou que finit l'*excitabilité*.

132. " 4° La moelle alongée, comme la moelle épinière et comme les tubercules quadrijumeaux, excite des contractions.

133. " A cette similitude de propriétés se joint une similitude parallèle d'organisation. La moelle épinière, la moelle alongée, qui n'est que la moelle épinière continuée, les tubercules quadrijumeaux, qui ne sont que la terminaison de cette moelle ; toutes ces parties, c'est-à-dire toutes les parties excitatrices de contraction, ont la substance grise en dedans et la substance blanche en dehors.

134. " Une disposition inverse de ces deux substances forme le caractère des parties non excitatrices, c'est-à-dire des lobes cérébraux et du cervelet*."

135. When the cerebrum is irritated, delirium ensues. When compressed, coma is induced. When lacerated, we have paralysis of *voluntary* motion. If other phenomena are seen in diseases of the encephalon, they arise from the extension of the influence of these to the true spinal and ganglionic systems, through *irritation*, or *pressure*, *counter-irritation*, or *counter-pressure*,—points of extreme importance, to be noticed very particularly hereafter.

136. In disorders of sensation, of the faculties of thinking, of volition, we must attend to the course of the sentient nerves, the condition of the encephalon, the course of the

* Recherches sur le Système Nerveux, p. 20—22.

nerves of volition. We must examine the state of the circulation, and the condition of the general system, and of the various organs, already enumerated, § 54. A thousand considerations press upon the mind of the intelligent and philosophic physician, when he views his patient, and endeavours to analyse and seize upon the important practical points of this complicated problem.

137. The different morbid forms of sensations, of the voluntary acts, of the mental functions,—spectra, tremor, mania, &c.—offer subjects of the most intense interest to the medical inquirer.

138. The olfactory, the optic, the acoustic nerves are, equally with the cerebrum and cerebellum, incapable of *pain*, or of *exciting movements* in the muscular system, when punctured or lacerated. They are, as I have stated and re-stated, the *seat* of the sentient principle—the soul; but they are not sentient themselves; and they are not endowed with the excito-motory principle.

139. But when the optic nerve is inflamed or irritated, there is impatience of light; when the membranes of the encephalon are inflamed and the cerebrum irritated, there is delirium. When these several textures are compressed, there is amaurosis, and coma, respectively; and when the cerebrum is lacerated, there is, as I have said, paralysis of voluntary motion.

140. But, in treating of the pathology of the cerebral system, a subject of the utmost interest comes to be considered. Not only undue arterial action, and venous congestion, induce morbid states of the cerebral functions, but the state of exhaustion from the loss of blood, the anæmious condition in chlorosis, &c. induce *similar* effects, and present to the physician anxious cases, which frequently try his skill in diagnosis. This subject has long occupied my attention, and several years ago I treated it expressly*.

141. There is, indeed, a marvellous connection between the nervous and vascular systems, throughout the animal frame; and no part of our structure strikes me with more admiration—with the *evidence of creation* more than this. In

* See "Observations on the Morbid and Curative Effects of Loss of Blood."

every contrivance of man, an agent is the *cause*, certain events are the *effects;* and thus the *series* may be extended. There is *sequence*. But in the constitution of every part of the animal frame, both nerve and artery are equally, synchronously, and mutually, co-essential; there is no succession of events, no sequence of cause and effect. The fact conveys to my mind the *idea of creation*, the *proof of a Creator*. But this argument, like a former one (§ 9), must be pursued on another occasion. To return to my subject—

142. Too great action of the minute arteries, congestion in the veins, an anæmious state of the vascular system of the encephalon, alike induce morbidly exalted and impaired conditions of the mental and cerebral functions: spectra, delirium, insomnia; amaurosis, stupor, coma; violent voluntary actions, or paralysis of the voluntary motions: these are the symptoms which arise out of these morbid conditions of the cerebral system and functions; and these only. Spasmodic actions depend upon the fact of another system being implicated.

143. This subject is well illustrated by the experiments of Sir Astley Cooper on the large arteries and veins of the neck of the dog and rabbit*,—experiments which I shall have to notice particularly hereafter.

144. The influences of position, of a whirling motion, &c. are also worthy of attention.

145. To the subject of the pathology of the cerebral system belong, too, the effects of the habits of anxiety of mind, of taking ardent spirits, of sexual excess and vice, &c. seen in the suicidal mania, and in the delirium tremens, in the half-maniacal, half-imbecile state of mind so frequently observed in such circumstances.

146. In order, then, to conceive a clear idea of the pathology of the cerebral system, we must imagine the physiological phenomena assuming a pathological character. Now the force of these phenomena may be augmented, diminished, or annihilated. In regard to the cerebral functions, we have, in the sentient nerves, pain or insensibility; in the cerebrum itself erroneous perceptions, judgments, and volitions, or

* Guy's Hospital Reports, vol. i, p. 457.

delirium; or a total deficiency of these faculties, or coma; in the motor nerves continual voluntary actions; or paralysis.

147. We may take the face, with its sentient and motor nerves, to illustrate a part of this subject. We may have morbid sensibility in the face; and this may assume the form of *tic douloureux*. We may, on the other hand, have loss of sensibility; this may arise from disease of the opposite hemisphere, or of the fifth nerve, within or without the cranium. The former case constitutes hemiplegia of the face; the latter cases have been particularly described by Sig. Bellingeri* and Sir Charles Bell†. We have in these affections interesting calls upon our resources for the diagnosis.

148. In hemiplegia, whilst there is usually paralysis of the muscles of the face, the loss of sensation is rarely complete, and the susceptibility of the nostrils to irritants is unimpaired; this was the case in a patient whom I recently examined, by the kindness of Dr. Watson, in the Middlesex Hospital. In the case of disease of the fifth within the cranium, the loss of sensibility is frequently complete, the nostril has also lost its susceptibility to the impression of stimuli, and eventually the eye, not being nourished, shrinks and collapses; the power of the masticatory muscles is impaired, but the face is not distorted by any *apparent* paralysis.

149. In paralysis of the face, from disease of the opposite hemisphere, the eye-lid can be closed, as represented in *Plate* VII, *fig.* 1;—in paralysis of the facial nerve, the orbicularis is paralysed, as we observe in *Plate* VII, *fig.* 2. What is the rationale of this difference? The seventh, like the fifth, is a compound nerve. As the latter embraces excitor and ganglionic filaments, which are not involved in the attack of hemiplegia, so the former comprises a branch belonging to the excito-motory system, which is not affected in disease of the cerebrum. These I have not thought it necessary to designate particularly.

150. Both the fifth and the seventh pairs of nerves are, then, more complex than they are represented to be by Sir Charles Bell. The former includes excitor and nutrient nerves, with the nerve of sensation; and it has appropriate

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* Dissertatio Inauguralis, 1818. † The Nervous System.

origins, distributions, and offices: of its offices, sensation alone is impaired by cerebral disease; but *all* are annihilated by the pressure of a tumor within the cranium. The seventh comprises pure cerebral and true spinal nerves: the cerebral only is affected in hemiplegia, and the orbicularis retains its power; all are paralysed by the pressure of a tumor below the ear, and we have paralysis of the sphincter of the eye-lid. This remark leads me to observe that *ptosis* is a cerebral paralysis, whilst *lagophthalmia* is one of the true spinal system: *strabismus* may be spasmodic or paralytic and belong to either.

151. It was well known to the ancients, that disease in one hemisphere of the brain induces paralysis in the opposite side of the body.

152. This fact has been confirmed by modern pathologists. It has been fully ascertained that disease confined to one hemisphere of the cerebrum, or of the cerebellum, and to one side of the mesial plane in the tuber annulare, constantly affects the *opposite* side,—whilst disease, confined to one of the lateral columns of the medulla oblongata and medulla spinalis, affects the *corresponding* side, of the muscular system. The encephalon has a *crossed effect;* the medulla spinalis a *direct effect.*

153. It has been further ascertained that, *in experiments*, lesions of the encephalon induce *paralysis only*, whilst lesions of the medulla oblongata and spinalis induce *convulsion* or *paralysis*, according to its severity. Hence it becomes an important question to determine the cause of convulsive affections in *disease* of the encephalon: to this question I shall pay particular attention immediately.

154. Such are the *facts* in reference to this subject. I must now briefly state that, formerly, Saucerotte*, in his Prize Memoir presented to the Académie Royale de Chirurgie

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* M. Flourens, du Système Nerveux, p. 223. Bouillaud de l'Encéphalite, p. 275. Saucerotte's words are—" outre le croisement des fibres médullaires d'un côté de la tête à l'autre, il y en a encore de la partie antérieure à la partie postérieure, et *vice versâ*, pour le mouvement des membres, de façon que l'origine des nerfs destinés aux mouvements des extrémités antérieures est dans la partie postérieure du cerveau, et réciproquement, dans l'antérieure pour les membres inférieurs." He then applies this view to the diagnosis of partial paralysis, of one or other extremity, from hæmorrhage.

in 1768; and, more recently, MM. Foville and Pinel-Grandchamp, M. Serres, M. Lacrampe-Loustau, and M. Bouillaud, have attempted to shew, that, besides this crossed effect of the cerebrum, affections of the corpus striatum, or its *middle lobe*, induce paralysis of the *inferior* extremities; whilst similar affections of the thalamus, or its *posterior lobe*, induce paralysis of the *superior* extremities; so that, if this opinion were true, there would be a *doubly crossed effect*. I use this phrase as a sort of *mnemonic* for those who may wish to speak of these opinions, for I fear I must call them by that name: M. Lallemand* and M. Andral†, after an examination of an extensive series of facts, have declared that the statement is without foundation. M. Bouillaud‡ has further attempted to shew, that disease, or lesion, of the *anterior lobe* of the cerebrum leads to a loss of the power of articulation. But this opinion is equally contested by the two authors whom I have just quoted.

155. I must now briefly notice an attempt to *localize* the affections of the brain of a different kind, but equally disputed by these pathologists: MM. Delaye and Foville have stated that the grey or cortical substance is principally affected in *mania*§; MM. Bouchet and Cazauvieilh‖, whilst they agree with MM. Delaye and Foville in their view of the pathology of mania, contend that in *epilepsy* it is, on the contrary, the white or *medullary* portion of the brain which is diseased.

156. The tubercula quadrigemina alone have a crossed effect, both of convulsion and paralysis¶.

157. M. Ollivier** observes that a hæmorrhagy into the tuber annulare only paralyses the movements; M. Cruveilhier††, on the contrary, asserts that such an affection destroys the sensations and the movements, but leaves the intellect

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* Recherches sur l'Encéphale, t. iii, p. 317, &c.

† Clinique Médicale, t. v, p. 357, &c.

‡ Traité de Encéphalite, p. 160, 276, &c.

§ See Rostan, Recherches sur le Ramollissement du Cerveau, p. 247; and Cours de Médecine Clinique, ed. 2, t. iii, p. 712.

‖ De l'Epilepsie, &c. p. 45.

¶ Recherches, &c. par M. Flourens, p. 119.

** Traité de la Moelle Epinière, ed. 2, t. ii, p. 527.

†† Anatomie Pathologique, Fasc. xxi.

uninjured. How many questions, then, still remain for future inquiry to solve!

158. I need scarcely add, in this place, that in those cases in which hæmorrhagy occupies an extensive space, affecting both hemispheres of the cerebrum,—as in meningeal hæmorrhagy at the summit, or at the base of the brain, in extensive hæmorrhagy within the brain, extending from one hemisphere to the other, or into both ventricles,—*general* paralysis is observed; the same event takes place in the cases in which a clot is formed in the mesial line in the tuber annulare,—the nodus encephali, as it has been termed.

159. Apoplexy and general paralysis are always serious. They are still more so when they affect the excito-motory system, inducing dysphagia, stertor, relaxed sphincters, &c.

160. Legallois, impressed with the idea that the spinal marrow was endued with the faculties of sensation and volition, experienced great difficulty in explaining the occurrence of paralysis from disease of the cerebrum. He observes, "Quand bien même on n'apercevrait aucun moyen de les concilier, il n'en demeurerait pas moins vrai, d'une part, qu'une affection bornée uniquement au cerveau peut ôter le sentiment et le mouvement volontaire à la moitié du corps, et de l'autre, que le sentiment et le mouvement volontaire peuvent subsister et être entretenus dans un animal décapité. Quelque opposés que ce faits paraissent être, il faut se souvenir que deux faits bien constatés ne peuvent jamais s'exclure l'un l'autre, et que la contradiction qu'on croit y remarquer tient à ce qu'il y a entre eux quelque intermédiare, quelque point de contact qui nous échappe*." The facts and principles which have been already detailed enable us readily to remove this difficulty, and to account for the paralysis induced by disease of the cerebrum, on one hand, and for the movements of an anencephalous fœtus in utero, or of a decapitated animal, on the other. The paralysis consists in the loss of *voluntary* motion; the movements of the anencephalous fœtus result from the agency of the *excito-motory* system. Legallois' error was that of mistaking the phenomena of the excito-motory system for sensation and voluntary

* Œuvres de Legallois, Paris, 1824, p. 21.

motion; and his difficulty naturally arose out of this error. There is no real discrepancy between the two orders of facts to which Legallois refers.

161. I must remark, that however distinct the cerebral and true spinal subdivisions may be, they exert an influence upon each other which is essential to the well-being of the individual. The anencephalous fœtus, though it may be born alive, and even live for some hours, is not *viable;* it must *soon* die. Apoplexy and hydrocephalus may destroy the patient by destroying the cerebral functions merely. During sleep even, although this be *chiefly* an affection of the brain, the functions of the true spinal marrow are somewhat impaired; the respiration is noisy, frequently slightly stertorous, and irregular. Yet the respiration does proceed, acts of deglutition take place, and the sphincters do their office. Still a marked distinction between the cerebral and the true spinal functions is, that the former are partly suspended in *sleep,* and entirely in *coma,* whilst the latter are unimpaired: in sleep and in slight coma the eye-lash is susceptible to the mildest stimulus, and the orbicularis—the sphincter of the eye-lid—and the other sphincters, with the muscles of the larynx and of the respiration, do their office. This state of things cannot last long, however, even in pure coma; because the integrity of the cerebral functions is essential to the continuance of the true spinal and the other functions of the animal economy. Hence the fatal omen attached to stertor, choaking, relaxation of the sphincters, and other morbid affections of the true spinal functions, in cases of cerebral disease, already noticed.

162. These last-mentioned symptoms are most frequently, however, dependent upon counter-pressure on the medulla oblongata in cerebral disease. If persistent, they are uniformly of fatal omen.

Section IV.—*The Therapeutics of the Cerebral System.*

163. Green tea is well known to excite insomnia, and opium sleep. And sleep is an affection of the cerebral system. Spirits and wine induce that condition of the cerebral system well known by the term inebriation, in which the perceptions,

the judgment, the acts of volition,—all functions of the mind,—are especially impaired.

164. There can be no doubt that the force of certain remedial and other physical agents is especially directed upon the cerebrum. This subject has been pursued experimentally by M. Flourens.* I subjoin the results of this eminent physiologist: "Il suit donc," says M. Flourens—

165. "1°. Que l'opium, à une dose et sous une forme déterminée, agit exclusivement sur les lobes cérébraux.

166. "2°. Que l'action spécifique de l'opium sur ces lobes reproduit exactement tous les phénomènes qui dérivent de leurs lésions mécaniques.

167. "3°. Qu'en agissant exclusivement sur ces organes, l'opium n'altère ou n'abolit que les fonctions que je leur ai attribuées dans mes précédens Mémoires.

168. "4°. Que l'action de l'opium sur les lobes cérébraux laisse toujours après elle des traces qui peuvent servir à la constater.

169. "5°. Qu'il y a telle dose qui n'agit que sur les lobes cérébraux, et laisse complètement intactes les parties mêmes les plus voisines.

170. 6"°. Enfin que, chez les petits oiseaux, on peut suivre à l'œil, et à travers les parois du crâne, la formation et le développement de l'altération organique de la partie, produite par l'action de la substance. (p. 254).

171. "1°. Que l'extrait aqueux de belladona, à une dose determinée, agit exclusivement sur les tubercules quadrijumeaux, et n'affecte conséquemment que le sens de la vue, c'est-à-dire que les fonctions de ces tubercules.

172. "2°. A une dose plus forte, la belladona étend son action sur les lobes cérébraux, et reproduit conséquemment alors tous les phénomènes de l'altération de ces organes.

173. "3°. Enfin, que l'action de la belladona se borne aux tubercules quadrijumeaux, et n'altère conséquemment que les fonctions de ces tubercules; ou qu'elle s'étende des tubercules quadrijumeaux aux lobes cérébraux, et conséquemment altère tout à la fois et les fonctions de ces lobes et celles de ces tubercules: cette action laisse toujours après elle des

* Recherches, &c. p. 242.

traces qui non seulement en manifestent le siége, mais circonscrivent encore, avec une exactitude parfaite, et les limites et l'étendue de ce siège." (p. 258.)

174. " 1°. Que l'alcool, à une dose déterminée, agit d'une manière exclusive et déterminée, sur le cervelet.

175. " 2°. Qu'en agissant ainsi exclusivement, ou, si l'on aime mieux, spécifiquement sur le cervelet, il n'altère que les fonctions seules que, dans mes précédens travaux, j'ai montré être l'attribut exclusif ou spécifique de cet organe.

176. " 3°. Que, passé cette dose appropriée, l'action de l'alcool s'étend du cervelet aux parties voisines.

177. " 4°. Que l'action de l'alcool laisse toujours après elle des traces matérielles qui servent à la faire reconnaître et à la constater.

178. " 5°. Que, dans les petits oiseaux surtout, la formation et le développement de ces traces sont apercevables à l'œil nu, même à travers les parois craniennes". (p. 261.)

179. " 1°. Qu'à une dose déterminée, la noix vomique se borne à produire des accès de convulsions et la gêne de la respiration, sans abolir les sens :

180. " 2°. Qu'à une dose plus forte, elle abolit les sens, produit des convulsions violentes, et enchaîne, en quelque sorte, le jeu de toutes les puissances respiratoires :

181. " 3°. Enfin, que, dans tous les cas, la partie du cerveau sur laquelle la noix vomique dirige plus particulièrement son action, est la moelle alongée." (p. 262, note.)

182. How much this subject requires fresh investigation, and how useful and open a field of inquiry it presents, I need not say. The effects of " moral treatment," of the different modes of lulling and soothing, of amusements and occupation, &c. also afford interesting topics of inquiry.

CHAPTER II.

THE TRUE SPINAL OR EXCITO-MOTORY SYSTEM.

183. I now proceed to treat of the True Spinal System, its anatomy, physiology, principle of action, pathology, and therapeutics. This system, formerly confounded with the cerebral, under the designation of cerebro-spinal,—this system, as a system, I consider as having been entirely elicited by my own laborious and persevering researches.

184. 1. *Its anatomy involves a system of incident, and reflex nerves, connected with the true spinal marrow as their centre; unknown, in this special connection, before;*

185. 2. *Its physiology consists in functions, all of which are performed through this peculiar anatomy. These functions comprise all the acts of Ingestion, of Retention, of Expulsion, and of Exclusion, in the animal œconomy; they are those, therefore, on which depend*

I. *The Preservation of the Individual, and*

II. *The Continuance of the Species.*

186. *All these functions are reflex-spinal functions, of which the idea did not formerly exist;*

187. 3. *Its principle of action is the vis nervosa of Haller, a motor power, of which, there was previously no application to physiology whatever;*

188. 4. *Its pathology comprises the whole Class of Spasmodic diseases, and its subdivision into those of*

1. *Incident,*
2. *Centric, and*
3. *Reflex, origin;*

189. 5. *Its therapeutics are similar to its pathology, the various physical agents, especially severe cold, sometimes acting on the incident nerves, sometimes on the spinal marrow itself, sometimes on the reflex nerves.*

190. Such is the *System* which my researches have unfolded and established, in the midst (I am sorry to say) of every kind of opposition, which malevolence and jealousy have

been able to invent. My second Memoir on the Nervous System was refused publication by the Royal Society, under the Secretaryship of Dr. Roget. My various publications were allowed to be criticised by a set of youths*, in their pupillage, and totally incompetent to their self-imposed task, in the British and Foreign Medical Review, edited by Dr. Forbes, and in the Medical Gazette, edited by Dr. Macleod. And what has issued from all this proceeding? It remains only to disfigure and disgrace our first scientific Institution and our medical literature.

190. Meantime the True Spinal *System*, in its *connected* anatomy, and physiology, principle of action, pathology, and therapeutics, remains,—remains as the result of my own unaided, unbefriended labours.

191. I say nothing of the *rewards justly due* to him who has made any successful effort in the cause of science.

Section I.—*The Principle of Action in the True Spinal System.*

192. As the immortal ψυχη is the source of all motion in the cerebral system, so the *vis nervosa* of Haller is the source of all action in the true spinal system.

193. In order that this fact might be clearly established, it was necessary to demonstrate that the *vis nervosa* acts in *other* and *very different* modes, from those assigned to it by Haller, by Bichat, Cuvier, Prof. Müller, &c.

194. *All* physiologists have agreed in stating, as a law of the action of this motor power, that it extends its influence in the direction *along* the spinal marrow *downwards*, and *from* the larger branches of nerves *towards* the smaller, or towards their extremities, *only*,—and *never* in the *contrary* direction.

195. Haller observes,—"Irritato nervo, convulsio in musculo oritur, qui ab eo nervo ramos habet. Irritato vero nervo, multis musculis communi, totive artui, omnes ii musculi covelluntur, qui ab eo nervo nervos habent, sub sede irrita-

* I may here give the names of Dr. Carpenter, of Mr. J. Durancé George, and, I believe, of Mr. Newport, who have *thus* begun their career; the latter two of Prochaska notoriety. See hereafter, § 253.

tiones ortos. Denique medulla spinali irritata, omnes artus convelluntur, qui *infra* eam sedem nervos accipiunt; *neque* contra artus, qui *supra* sedem irritationis ponuntur." He concludes—"conditio illa in nervo, quæ motum in musculis ciet, *desuper* advenit, sive a cerebro et medulla spinali, *deorsum*, versus extremos nervorum fines propagatur," and—"ut adpareat *causam motus a trunco nervi in ramos, non a ramis in truncum venire**."

196. Bichat observes,—"L'influence nerveuse ne se propage que de la partie supérieure à l'inférieure, et jamais en sens inverse. Coupez un nerf en deux, sa partie inférieure irritée fera contracter les muscles subjacens; on a beau exciter l'autre, elle ne détermine aucune contraction dans les muscles supérieurs; de même la moelle, divisée transversalement et agacée en haut et en bas, ne produit un effet sensible que dans le second sens. Jamais l'influence nerveuse ne remonte pour le mouvement, comme elle le fait pour le sentiment†."

197. Cuvier, in his report on the admirable work of M. Flourens, observes—"Toute irritation d'un nerf le met en jeu dans les muscles *où il se rend.* Toute irritation de la moelle la met en jeu dans les membres placés *audessous* de l'endroit irrité‡."

198. Prof. Müller treats this subject still more at length, and has laid down the following laws in regard to the mode of action of the motor powers:—

199. "The motor power acts *only* in the direction of the primitive nervous fibres going to muscles, or in the direction of the branches of the nerves; and *never backwards.*"

200. "*All* nervous fibres act in an isolated manner *from the trunk* of a nerve *to its ultimate branches*§."

201. This mode of action is represented, *Plate* III, *fig.* 2, which may be said to represent the state of our knowledge on this subject when I began my researches.

202. I must now adduce a series of new experiments,

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* Elementa Physiologiæ, Lausannæ, t. iv, p. 325.

† Anatomie Générale, 1801, tom. iii, p. 277.

‡ Recherches du Système Nerveux, par P. Flourens, p. 83.

§ Handbuch der Physiologie, i, 656, 659.

which clearly prove that the same power acts in other modes and according to a newly discovered law, which enables us, for the first time, to apply it to physiology. I cannot state this subject in plainer terms than in an extract from a letter which, when the Philosophical Transactions were closed to me, I thought it best to address to Prof. Müller, and which appeared in the *Archiv für Physiologie* for 1840.

203. 'I must first observe that it has always appeared to me to be a remarkable circumstance in the history of physiology, that the *vis nervosa*, so universally admitted as a motor principle in the animal economy, as deduced from *experiment*, has hitherto had no application whatever to the explanation of its functions, or to actual physiology. *It presents the anomaly of a principle of action, hitherto without application.*

204. 'Another fact of a similar character also exists in the history of *experimental* physiology. Redi, Whytt, Blane, Legallois, &c. observed a series of phenomena displayed in the trunk and limbs of decapitated animals: when, for example, we remove the head of a kitten, or a tortoise, and irritate a limb, that and the other limbs are immediately moved with great energy. In the first place, the motor *principle* in these experimental phenomena remained undetected; in the second, the phenomena themselves, like the *vis nervosa*, remained as mere facts, without application to the illustration of the physiology of the healthy living functions.

205. 'I have, I believe, by means of a series of experiments, about to be detailed, shewn—that the *vis nervosa* acts according to other and different laws from those previously assigned to it by physiologists, that it is the motor principle in the experiments on decapitated animals to which I have adverted, and that it has, with these experiments, a most extensive application to physiology, and not to physiology only, but, in reference to its special *seat*, to anatomy, and, in reference to certain morbid actions, to pathology.

206. '*Experiment* I.—I took a turtle (the *chelonia mydas*) and having removed the head, laid bare the spinal marrow by sawing away a longitudinal portion of the posterior part of the shell; I then irritated that organ by means of the galvanic influence, the forceps, &c.

207. '1. I had, first, the phenomena of sudden motions in

both the posterior extremities, and in the tail, according to the law of Haller. *Plate* III, *fig.* 2, 3.

208. ‘ 2. But I had also slower and more continual movements in the anterior extremities, establishing a *new Law* of action of the *vis nervosa, upwards* in the course of the spinal marrow. This experiment is depicted in *Plate* III, *fig.* 3.

209. ‘ Before I proceed, I must briefly notice that experiments which might appear somewhat similar to this, had been made both by M. Flourens* and yourself†; but they were not made on *decapitated* animals, and were not therefore identical with it; sensation and volition were not excluded, and the phenomena were not limited to the agency of the *vis nervosa,* as, I believe, they are in mine. Nor were they made so as to display, from one and the same application of stimulus, both the *upward* and *downward* influence of their motor power, proving their *identity;* for no one, I think, can doubt this latter inference.

210. ‘ *Experiment* II.—I now removed all the viscera, and denuded the lateral nerves and divided them near their extremities; I then irritated the part still attached to the spinal marrow, by means of galvanism and the forceps, as I had previously done the spinal marrow itself.

211. ‘ I had immediately slow and continuous movements of all four extremities and of the tail.

212. ‘ In this experiment, contrary to the law of Haller, the *vis nervosa* or motor influence acted in directions *from* the branches of the nerves, *towards* their trunks, *into* the spinal marrow, and *upwards* as well as downwards in the spinal marrow. This experiment is pourtrayed, *Plate* III, *fig.* 4.

213. ‘ As I believe no one can doubt that, in Exp. I, it is the same *vis nervosa* which acts in the upward and in the downward directions, so I presume that no one can doubt that it is the same *vis nervosa* which acts in the incident direction *into* the spinal marrow, and then in the upward and downward directions *along* the spinal marrow, and, lastly, in *reflected* directions into the extremities, in Exp. II.

214. ‘ *Experiment* III.—Instead of irritating any part of the nervous textures isolated from the rest, I now irritate, in

* Du Système Nerveux, p. 12—13, 112—113.

† Handbuch der Physiologie, i, p. 625, 632.

succession, the *cutaneous* surfaces of the body and of the limbs, as shewn in *fig* 4, *a*, *b*, *c*.

215. ‘ I had precisely the phenomena observed in Exp. II.

216. ‘ But this is the old experiment of Redi, Whytt, &c. on decapitated animals. Are we not, then, entitled to conclude, that these phenomena depend, like those of Exp. I and II, on the *vis nervosa* of Haller? If this conclusion, which I regard as indubitable, be admitted, besides being of much importance in itself, it will, I think, lead us to others of extensive application in physiology.

217. ‘ *Experiment* IV.—In this experiment I passed on from the *cutaneous* surfaces to the *cutaneo-mucous*, and irritated, first, the border of the eye-lids, and then that of the sphincter ani. *Plate* III, *fig.* 5, *a*; *fig.* 4, *d*.

218. ‘ The eye-lids closed; the sphincter contracted.

219. ‘ But these last are not mere *experiments;* they are *physiological acts*. And in them we have, I think, the first application of the *vis nervosa*,—of the motor principle of the experiments of Redi, Whytt, &c.—to physiology. For no one can, I think, doubt that the motor principle in the last and in the first of this series of experiments is the same.

220. ‘ But this is not the only conclusion from this experiment. The phenomena ceased on dividing either the spinal marrow, or the incident or reflex nerves, in any part intervening between the point irritated and the part moved. These movements, then, and these physiological acts, depend upon a special system of incident nerves, the spinal marrow, and reflex nerves, whose characteristic is, that they are endowed with the *vis nervosa*. This system is co-extensive with the phenomena made apparent by them; and it is, consequently, to be determined, not by argument, but by actual *experiment*. I make this cursory remark, in this place, in reply to the observations of Prof. Volkmann, published in the *Archiv für Physiologie*, for 1838, p. 38.

221. ‘ *Experiment* V.—I next took the separated head of the turtle, and irritated, by means of galvanism and the forceps, the lower end of the medulla oblongata and of the pneumogastric nerve; I then passed a probe so as to irritate the *mucous* membrane of the nostrils, the palatine fringes, and the larynx. See *Plate* III, *fig.* 5, *b*, *c*, *d*, *e*.

222. In all these cases, an act of *inspiration*, denoted by the descent of the submaxillary tissues, was immediately induced. This phenomenon ceased on withdrawing the medulla oblongata.

223. I had occasion to repeat Experiments I and II at La Pitié, in Paris, in the presence of M. Serres, our friend Mr. Walker, my friend le Dr. Maurice Gariel, and other gentlemen. The following are the notes taken at the time by Dr. Gariel, under whose care sketches were made by M. Beau :

" *Expériences faites sur une Tortue, la tête étant séparée du tronc, entre la 3e et la 4e vertèbres cervicales.*

Hôpital de la Pitié, le 10 *Août*, 1837.

224. " 1*e Expér.*—Lorsqu' avec un stylet, l'on toucha la partie de la moelle épinière mise à nu par la section de la 3e vertèbre (du côté de la tête), l'on détermina des mouvemens d'inspiration.

225. " 2*e Expér.*—Quatre traits de scie, deux longitudinaux distants d'un demi pouce, les deux autres transversaux, distants d'un pouce, ayant été portés sur la partie centrale de la carapace, on mit la moelle épinière à nu au niveau de la région dorsale, par conséquent au dessous du niveau de la naissance des nerfs qui se rendent aux extrémités supérieures ; lorsqu' on la toucha avec un stylet, on qu'ou l'excita au moyen du galvanisme, on produisait des mouvemens de tous les membres et de la queue.

226. " 3*e Expér.*—Ayant mis à découvert un nerf intercostal, après avoir enlevé les organes contenus dans l'intérieur de la carapace, on le stimula par les mêmes moyens et l'on obtint le même résultat que dans la 2e expérience.

227. " 4*e Expér.*—En stimulant les surfaces cutanées et muqueuses, telles que celles de la face, des narines, &c. (la tête étant séparée du tronc), l'on détermina les mêmes mouvemens que dans l'expérience 1e.

228. " 5*e Expér.*—En soulevant et isolant sur un petit rouleau de papier la moelle épinière au point où elle était à découvert, comme dans l'expérience 2e, et en stimulant la face postérieure, on détermina des mouvemens des quatre

membres et de la queue. En stimulant la face antérieure, on détermina les mêmes mouvemens, mais avec plus d'énergie encore*.

229. " 6*e Expér.*—En touchant avec un stylet le sphincter de l'anus, qui reçoit ses nerfs au dessous du point où les membres postérieurs reçoivent les leurs, on détermina des mouvemens très-énergiques dans les membres postérieurs et la queue."

230. When we compare these facts with those elicited in the separated head and represented in *Plate* III, *fig.* 5, we cannot, I think, hesitate to conclude that it is the same identical power which acts in the experiments of Haller, in the experiments of Redi, Whytt, &c. and in the excited acts of the closure of the eye-lids, of inspiration, &c.

231. A further series of experiments, to be detailed shortly, shew that *all* the acts of ingestion and of egestion depend upon the same principle.

232. I have now to remark, more particularly than before, that an experiment *similar* to that in *Plate* III, *fig.* 3, was performed by M. Flourens† and Prof. Müller‡; but in these *the animal was not decapitated;* the action of the special motor power could not therefore be distinguished from the influence of *sensation and volition;* and the experiment therefore *was not the same.*

233. The experiments of M. Flourens I give in his own words:

234. " J'interceptai, sur un lapin, par deux sections, une portion déterminée de la moelle épinière dorsale. Je détachai tous les nerfs de cette portion; après quoi, j'irritai tour à tour, en avant, en arrière, ou entre les deux sections.

235. " Lorsque j'irritais en arrière, il n'y avait que des convulsions; lorsque j'irritais en avant, les convulsions s'accompagnaient de *douleurs;* lorsque j'irritais entre, il n'y avait ni convulsions ni douleurs." (p. 13.)

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* I have stated, in my " Memoirs on the Nervous System," p. 44, note, that, in the *turtle* and the *skate (Raia batis)*, galvanism applied to the *posterior* or *anterior* roots of the spinal nerves equally induced muscular action.

† See Système Nerveux, p. 13 and p. 113.

‡ Handbuch der Physiologie, t. i, p. 632.

236. " J'ai mis à nu, sur un troisième pigeon, toute l'étendue de moelle épinière comprise entre les deux renflemens."

237. " Lorsque j'irritais à une égale distance des deux renflemens, les convulsions se manifestaient également aux jambes et aux ailes ;

238. " Lorsque, au contraire, j'irritais en-deça ou au-delà de ce point mitoyen, les convulsions prédominaient, ou même, si l'irritation était légère, se bornaient aussitôt ou aux jambes ou aux ailes, selon que le point irrité était plus voisin des unes ou des autres." (p. 113.)

239. The experiments of Prof. Müller were made on the frog, and, besides the circumstance of the influence of the cerebrum being allowed to remain, the result of the experiment on the roots of the nerves was *different* from that of mine, repeatedly performed, with invariable results, on the turtle and the tortoise, as will be seen by the subjoined paragraph, translated from the "Handbuch der Physiologie," vol. i, p. 632; ed. i, 1834:

240. " I now wished to know whether the roots of the last spinal nerves, when they are cut at some distance from the spinal marrow, and when the commencement of the roots *still adhering to the spinal marrow* are armed, are in a condition to excite convulsions in the anterior portions by means of the spinal marrow. The results were constant, but unexpected.

241. " Neither the anterior nor the posterior roots, if they alone are simply armed, cause movements in a retrograde direction, in the anterior portion of the body, as, for instance, in the head. It thus appears that the fibres of the nerves in the spinal marrow do not communicate. Convulsions, however, took place when the roots were armed with one pole, and the bare anterior portions of the body with the other, which again takes place by the conduction of the galvanic current to the distant motor nerves.

242. "Lastly, I divided, in a frog, all the roots of the nerves in the greater part of the spinal marrow, from behind to the region of the arms, adjacent to the spinal marrow, so that the posterior portion of the spinal marrow could be freely raised and a glass disc placed beneath it. The extremity of the

spinal marrow, connected with both poles, excited convulsions in all parts still remaining in connection with the spinal marrow. From this last experiment it follows that the spinal marrow is not merely the *ensemble* of the nerves of the trunk, as I had imagined, but that it has indeed some things in common with the nerves, whilst in others it differs from them; for the roots of the spinal nerves produce, when immediately excited, no convulsions in a retrograde direction in the anterior portions; but the extremity of the spinal marrow does."

Section II.—*The Anatomy of the True Spinal System.*

243. In the former Section of this Chapter, I have, I think, demonstrated a new kind of action of the *vis nervosa*, and, physiologically speaking, a new kind of nerve; that is—

I. *An Incident Motor Action*, and

II. *An Incident Motor Nerve.*

244. May I not affirm that this statement is the pure expression of *facts*, and destitute of *all hypothesis?* for I speak not of *fibres* or of *filaments*, about which there has been so much discussion, and may be some doubt; but of an obvious action in an obvious nerve.

245. This incident motor nerve, thus *demonstrated*, is but one of a *System* of incident nerves, equally the expression of *facts*, equally destitute of *hypothesis*, and *nôt* to be found in the admirable works of *Prochaska*, or of *M. Flourens*, or of *any* physiologist with whose labours I am acquainted. It is, in a word, the *basis* of that *System of nerves*, and, I may add, of *functions*, to which I have alluded; it is that basis without which that system could not be satisfactorily established.

246. I have hitherto spoken of the *trunk* of one of the incident, excitor, or motor nerves. But I must now observe that the extreme terminations or distributions of these nerves possess the excitor or motor, or, as I have ventured to express it, the excito-motory power, in a much higher degree than their trunk. If, having removed the head of a frog, we divide the integuments along the back, and raise them by means of the forceps, we observe the trunks of many cutaneous nerves; now if we irritate these trunks, no move-

ments follow; but, if we irritate the cutaneous textures on which they are distributed, movements of a very energetic character are produced*.

247. This fact has been noticed more recently by Prof. Volkmann. It is important in a physiological point of view.

248. *Exp.* I now revert to my detail of the series of experiments on the decapitated turtle. If we irritate the nostrils, or the palatine fringes, we excite, through the *trifacial nerve*, an act of inspiration. If we irritate the larynx by passing a probe along the trachea, we produce the same effect through the medium of the *pneumogastric* nerve. A similar phenomenon is produced by irritating the trunk of the pneumogastric itself, or the substance of the spinal marrow, near the points of their division respectively. *Plate* III, *fig.* 1.

249. Have not these experiments proved, without one word of argument, the existence of *two incident* nerves possessing *the special excito-motory property?* Do we not perceive the beginnings of *the System of incident excitor nerves* to which I have alluded?

250. Do we not further perceive that these nerves are not only excitors of muscular action, but, in the case last detailed, of *the act of inspiration?* And do we not now plainly perceive the first application of the "*vis nervosa*" of Haller, and of the *System* of incident nerves, through the medium of which it acts, to *Physiology?* If I seem to ask this question more frequently than would be necessary simply to state the argument, I must remark, in explanation, that I am *compelled* to adopt a style which is not that of my choice (see § 190). I know that truth must eventually triumph over malevolence; but then the victory may be tardy, and this alone is injustice.

251. This *System* of nerves is displayed in *Plate* I, and in the subjoined *Table:*

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* "Memoirs," p. 41, § 21.

TABLE OF THE ANATOMY OF THE TRUE SPINAL SYSTEM.

I. *The Incident Motor Branches.*
1. *The Trifacial, arising from—*
1. *The Eye-lashes.*
2. *The Alæ Nasi.*
3. *The Nostril.*
4. *The Fauces.*
5. *The Face.*
2. *The Pneumogastric, from*
1. *The Pharynx.*
2. *The Larynx.*
3. *The Bronchia.*
4. *The Cardia,—Kidney, and Liver.*
3. *The Glosso Pharyngeal?*
4. *The Posterior Spinal, arising from—*
1. *The General Surface.*
2. *The Glans Penis vel Clitoridis.*
3. *The Anus.*
4. *The Cervix Vesicæ.*
5. *The Cervix Uteri.*

II. *The True Medulla Oblongata and Medulla Spinalis, the Centre of the System.*

III. *The Reflex, Motor Branches.*
1. *The Trochlearis* } *Oculi.*
2. *The Abducens* }
3. *The Minor portion of the Fifth.*
4. *The Facial, distributed to*
1. *The Orbicularis.*
2. *The Levator Alæ Nasi.*
5. *The Pneumogastric or its Accessory.*
1. *The Pharyngeal.*
2. *The Œsophageal and Cardiac.*
3. *The Laryngeal.*
4. *The Bronchial, &c.*
6. *The Myo-glossal.*
7. *The Spinal Accessory.*
8. *The Spinal, distributed to the*
1. *Diaphragm, and to*
2. *The Intercostal and* } *Muscles*
3. *The Abdominal* }
9. *The Sacral, distributed to*
1. *The Sphincters.*
2. *The Expulsors, the Ejaculators, the Fallopian Tubes, the Uterus, &c.*

252. Until the period of my researches, the pure motor power of the nervous system had never been applied to physiology—the idea of an *incident motor* nerve did not exist; and, consequently, the *System* of such nerves, and the special *Physiology* of this system, was totally unknown.

253. It has been eagerly attempted to transfer the credit of what I have done to others, and especially to Prochaska on the one hand, and to M. Flourens on the other. But I affirm that the idea of an *incident motor* nerve does not exist in either of the authors, and that therefore the *System* of such nerves, with their *Physiology, cannot* exist in them. In fact, Prochaska goes no further than Whytt? He alludes to a *reflex* action, as seen in the *very obvious pathological* phenomena of sneezing, coughing, &c.; and then all is confusion; for with these phenomena are associated, as of a *similar* character, the motion of the arm to the head *said* to take place in apoplexy! the motion of the eye-lids when a person approaches your eye with a finger! the motion of the *heart!* of the *intestines!*

&c. It is impossible to argue with persons of such confusion of ideas. And for M. Flourens, he does not make the slightest allusion to an *incident* motor action, or an *incident* motor nerve, or to a *reflex* action; and yet all the functions to which I now refer, *are* reflex, and effected by means of such a power and through the medium of such nerves! On the contrary, M. Flourens states a thousand times, in his beautiful work, which is a model of physiological investigation, that respiration, for example, has its *primum mobile* in the medulla oblongata; whereas it *has* its primum mobile in *incident excito-motory nerves*. To complete the evidence on this point, I may quote a letter which I received from M. Flourens, in which he states—"*Votre beau système des nerfs* excitateurs, incidens *et* réfléchis, *vous appartient bien, et comme grand fait spécial et déterminé, et comme vue d'un grand et nouvel ensemble de phénomènes.*"—February 3, 1839.

254. I have been led to make these remarks by the criticisms already noticed, (§ 190).

255. *All* the nerves represented on the left side of this Table are *incident motor nerves*. Some of them are *sentient;* but, whether sentient or not, they are demonstrably *excito-motor*, and, whilst they are *motor* they are *incident*. If we do not allow these two words—these two ideas—to be disjoined in our mind, there will be an end of all dispute.

Section III.—*The Physiology of the True Spinal System.*

256. By the cerebral system, we are placed in relation to the external world *psychically*, or *mentally;* by the true spinal system we are placed in a similar relation *physically*. As by the former we imbibe all our ideas, so by the latter we appropriate external objects to our very substance. On the true spinal system all ingestion, all retention, all expulsion, in regard to the animal frame and œconomy, depend.

257. *Every* such act is a *Spinal* act, a true spinal act, reflex in its form and character, accomplished through the *medium* of the incident, and reflex nerves, and their connecting centre the true spinal marrow, and by the *agency* of the *vis nervosa*.

258. All this has been made out by my own labours. The

only act of ingestion ever referred to the spinal marrow previously, was the act of respiration; this was discovered by Legallois (whose results are confirmed by M. Flourens), to be necessarily connected with that precise part of the medulla oblongata which gives origin to the pneumogastric nerves.

259. This part of the medulla oblongata, Legallois, M. Flourens, Sir Charles Bell, Prof. Müller, and, I believe, all physiologists, considered as the *primum mobile* of this important function. The idea of a *reflex function* did not exist. The idea of an *incident action*, of an *incident nerve*, did not exist. It was not possible, therefore, to assign to the pneumogastric and other incident nerves, their proper functions of incident *excitors of respiration.*

260. But not only respiration, but all the functions of ingestion and of egestion are of the same character: they are all *spinal;* they are all movements of which the *vis nervosa* is the *agent*, the incident and reflex nerves in their connection with the true spinal marrow the *media*, and the reflex action the *form.*

261. It was known that the muscles proper to these functions might suffer from paralysis. But the idea was a vague one. This paralysis was not defined as being either cerebral or spinal. It was not, could not be, understood.

262. That a principle so extensive and important in the animal œconomy should not have been detected and made known before, must appear extraordinary. And that such is the fact, may be demonstrated by considering the most simple and familiar examples of the functions over which this principle presides. Has it been stated in any work, ancient or modern, that the deglutition of water by the pharynx, the exclusion of carbonic acid by the larynx, the retention of the urine and fæces by the sphincters, are exclusively functions of the *spinal marrow*, *and* of a peculiar *System* of *excitor* and *motor* nerves, of which it is the centre or axis? I have looked, in vain, over the works of Dr. Bostock, Dr. Alison, and of Mr. Mayo; of M. Adelon, and M. Magendie; and of Rudolphi and Prof. Müller, for an account, or even a hint, of such a principle, as involved in these familiar acts.

263. Nay, the idea of a system of *excitor* nerves, constantly operating in the animal œconomy, preserving its orifices

open, its sphincters closed, and constituting the *primum mobile* of the important function of respiration, I believe, as I have already stated, to be new. The same remark applies to their centre, the spinal marrow, and the reflex nerves in connection with them, viewed as *parts* of the *system*. The acts are so familiar to us, that we have thought them understood when the nervous agents through which they have been *excited* have not even been detected. Yet, that this view is the true one, is proved by the most decisive experiments.

264. The nearest approximation to the detection of this system is to be found in relation to the closure of the eye-lid on touching its borders. M. Magendie observes*, " Le mouvement, nommé *clignement*, dépend en partie du nerf facial, et en partie du nerf de la cinquième paire. Il cesse quand le nerf facial est coupé ; il cesse ou ne se montre que très-rarement, et seulement par l'effet d'un rayon directe de lumière solaire, quand le nerf de la cinquième paire est divisé. La perte du mouvement des paupières par la section, ou la paralysie du nerf facial, s'entend facilement, puisque ce nerf envoie des filets au muscle orbiculaire. *Il est beaucoup plus difficile de comprendre comment la section de la cinquième paire arrête le clignement, car ce nerf, presque entièrement destiné à la sensibilité, n'envoie aucune branche aux muscles qui font mouvoir les paupières.*" Mr. Mayo observes†, " The muscle which closes the eye-lids is called the orbicularis palpebrarum ; it is disposed for some breadth beneath the skin of the eye-lids in concentric fasciculi. *This muscle is supplied by the fifth nerve*, and by the portio dura of the seventh, and is paralysed by the division of the latter. The fifth nerve and the seventh rise together ; the fifth imparts sensibility to the eye, to the eye-lids, and eye-lashes ; and the least irritation of these parts calls into action the orbicularis palpebrarum, which receives its stimulus through the portio dura of the seventh."—" The *consent* between the fifth and the seventh nerve," &c‡. These two eminent physiologists are at variance in their anatomy, but obviously attach importance to the

* Précis de Physiologie ; Paris, 1833, t. i, p. 51. Compare the " Journal de Physiologie," t. iv, p. 176.

† Outlines of Physiology, 3rd ed. p. 307.

‡ Opus cit. p. 308.

question of the distribution of the fifth to the orbicularis itself—so excluding the very idea of a *reflex* action: the former confesses the difficulty of explanation of the phenomenon; the latter attaches importance to the identity of *origin*, referring the phenomenon to some "consent" between the two nerves,—an opinion controverted with perfect success by Dr. Alison* and Prof. Müller†. Neither Mr. Mayo nor M. Magendie appears to see that the act involves a reflex, excito-motory agency, carried on through the medium of the true medulla,—a fact which is proved by experiments in which the fifth pair of nerves, the medulla, and the seventh pair of nerves, are respectively divided. The central and connecting link between the two nerves, as between the excitor and motor nerves of the true spinal system generally, and in all the acts of ingestion and egestion, of the orifices and sphincters, is overlooked. See *Plate* IV, *fig.* 1.

265. I may now present my reader with the following *Table* of the Physiology of the excito-motory system, which must be carefully compared with the *Table*, p. 50, and with *Plate* I. He will not fail to make one remark: that the *throat* is the principal region of the *orifices;* the lower *pelvis*, of the sphincters, &c. These (with that of respiration) are the chief regions, both of the physiology and of the pathology of the true spinal system; a line drawn across them would pass through the organs principally affected in hydrophobia, tetanus, epilepsy, hysteria, &c. This *Table* further presents you with the *physiology* which corresponds to the *anatomy*. It presents you with an arrangement of the functions of *ingestion* and *egestion*, of the *orifices* and of the *sphincters*. No one has pretended, except in the vaguest manner, and under the shelter of the phrase, "*sympathetic actions*," that this extensive view of the subject had been taken before. Prof. Müller distinctly states (Trans. p. 803) that the *reflex actions* have a limited place in *physiology*. Neither Prochaska nor M. Flourens names *one* of these functions!

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* Trans. of the Med. Chir. Soc. of Edinb. vol. ii, p. 165; and Outlines of Physiology, 1833, p. 269.

† Handbuch der Physiologie, 689.

TABLE OF THE PHYSIOLOGY OF THE TRUE SPINAL SYSTEM.

I. *The Excited Action—*
- 1. *Of the Eyes, the Eye-lids; (and of the Iris ?)*
- 2. *Of the Orifices.*
  - 1. *The Larynx.*
  - 2. *The Pharynx.*
- 3. *Of the Ingestion.*
  - 1. *Of the Food.*
    - 1. *In Suction;*
    - 2. *In Deglutition.*
  - 2. *Of the Air, or Respiration.*
  - 3. *Of the Semen, or Conception.*
- 4. *Of Exclusion.*
- 5. *Of the Expulsors, or of Egestion.*
  - 1. *Of the Fæces;*
  - 2. *Of the Urine;*
  - 3. *Of the Perspiration;*
  - 4. *Of the Semen;*
  - 5. *Of the Fœtus, or Parturition.*
- 6. *Of the Sphincters.*
  - 1. *The Cardia.*
  - 2. *The Valvula Coli?*
  - 3. *The Sphincter Ani.*
  - 4. *The Sphincter Vesicæ.*

II. *The Direct Action or Influence—*
- I. *In the Tone,*
- II. *In the Irritability,* } *of the Muscular System.*

266. In the *Anatomy** of the excito-motory system there is a rich mine to be explored! In the investigation, two modes may be pursued—dissection and experiment. Sir Charles Bell† applauds the former, M. Flourens‡ the latter; but all must be agreed that these two methods should be regarded, "not as rivals, but as allies§."

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* See my "Memoirs on the Nervous System," Memoir I, Pref. p. i, § 8, 124—126; II, § 29—39, 114, 115; and my "Lectures," p. 33.

† The Nervous System, p. 217.

‡ Du Système Nerveux, p. xxi.

§ See Memoir I, § 64, note.

267. The True Spinal Marrow may be correctly viewed as a distinct *organ*, totally different in its properties and functions from the cerebrum, and as the centre of a distinct system of nerves, different from the sentient and voluntary, and possessed of a peculiar and special motor power, which acts in incident as well as reflex directions, for special purposes—judging entirely from *experiment*. It may be received as a principle, that every part of the nervous system, which is endowed with the excito-motory power, belongs to this system, whether this power be exerted in the direction of the nerves *from* or *towards* the nervous centres. We have in a simple experiment, therefore, an easy mode of ascertaining what part of the general nervous system belongs to that subdivision of which I am treating. It would be interesting to determine this question in reference to each part of the nervous system of the various Classes of animals.

268. As each nerve of the excito-motory system, with the exception, perhaps, of the pneumogastric, is a compound nerve, having a cerebral as well as a true spinal origin, it becomes an interesting question whether these may be traced by the scalpel. This question is peculiarly interesting in reference to the trifacial and facial nerves. Experiment and pathology have already shown us, that the cerebral part of the function of these nerves may be obliterated, whilst the excito-motory property remains in them unimpaired*. See § 150.

269. But we have other means still of investigation. A mechanical, or the galvanic stimulus, or heat, applied to the excito-motory system, induces immediate contraction in a system of muscles, in a limb, or in a single muscle, according as an incident nerve, the centre of the system, or a motor nerve, is exposed to their influence. Strychnine induces a continued state of tetanus of the whole excito-motory system, which ceases entirely, or in parts, according as the centre of the system, a part of it, or a motor nerve, be divided or destroyed.

270. These agencies afford us, therefore, *means* of investigation. They are, in reference to the blended anatomy of the excito-motory system, what the scalpel is to the anatomy of other systems.

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* See particularly my "Lectures," § 73—75.

271. Facts in the blended anatomy, thus ascertained, may lead to the discovery of strictly anatomical facts, in the *Articulata*, or other Classes, in which the anatomy of the different nervous sub-systems may be distinct.

272. In tracing the Anatomy, we must advert to the *peripheral origin*, as well as the *muscular insertion*, of incident and reflex nerves; *and*, as Rolando, Bellingeri, Spurzheim, and Mr. Grainger have done, to their *connections* with the *spinal marrow*.

273. It becomes obvious that, if a nerve be compounded of sentient and excitor filaments, it has, probably, two origins, one in the cerebrum, the other in the medulla. The same remark is true of the nerves compounded of voluntary and motor fibres (see § 150). Is it possible to trace this structure in any part of the zoological series? What an interesting subject for the scalpel and for experiment!

274. I believe an objection has been raised against designating a nerve, known to be a sentient nerve, an excitor nerve: but the question is one not of words, but of facts. Is the trifacial a sentient nerve? If so, let it be so designated. Is it also an excitor nerve? If so, there is the same reason for designating it by this epithet. In short, it is not only sentient *and* excitor, but it is, probably, nutrient too. And any view of the subject short of this is distant from the truth. In the same manner, the pneumogastric must be viewed, not as a mere sentient or secretory nerve, but as emphatically *the Internal Excito-motory nerve*.

275. The next enquiry would be, What are the *special* motions produced by stimulating given incident nerves? The most usual effect produced is a motion of the limbs. But in other instances we have acts of inspiration, of deglutition, of expulsion,—of closure in the eye-lids, larynx, pharynx, and the sphincters:—interesting facts, which speak a physiological language, and assign distinct and special offices to certain excitor nerves.

276. These excitor nerves may be viewed as *guards* of the orifices and exits of the animal frame, as seen in the subsequent *Table:*

TABLE OF THE GUARDS OF THE ORIFICES.

I. *The Trifacial guards—*
1. *The Eye.*
2. *The Nostril,—the Ear in the Cetacea.*
3. *The Fauces.*

II. *The Pneumogastric guards—*
1. *The Larynx, the Bronchia.*
2. *The Pharynx, the Cardia.*
3. *The Ureter, the Gall-duct.*

III. *The Spinal Nerves' guard—*
1. *The Rectum.*
2. *The Bladder.*
3. *The Vesiculæ Seminales.*
4. *The Uterus.*

277. With each part of this series of excitor nerves are connected, through the spinal marrow, a corresponding set of motor nerves. It is impossible to view the subject, free from bias and prejudice, without acknowledging it to be one of intense interest.

278. I now proceed to treat of the special functions of the true spinal system. The first of these, which I shall notice, is

I. *The Closure of the Eye-lids.*

279. I have already repeatedly adverted to this subject, and I have shewn (§ 264) that M. Magendie and Mr. Mayo fail to explain it, although both distinctly mention the influence of the fifth and seventh pairs of nerves. A series of interesting experiments demonstrate that the agencies of these two nerves, like those of all the excitors and motors in the reflex function, are combined by the medulla oblongata.

280. The phenomenon of the closure of the eye-lid on touching the eye-lash is represented in *Plate* IV, *fig.* 1, and in the subjoined *Table:*

TABLE OF THE CLOSURE OF THE EYE-LID.

I. *The Excitor.*	II. *The Centre.*	III. *The Motor.*
The palpebral branch of the Trifacial.	*The Medulla oblongata.*	*The Orbicular branch of the Facial.*

281. I may refer to the experiment on the horse, detailed in a former page, § 32, in which, when sensibility was destroyed, the light touch of a straw upon the eye-lash induced

a forcible closure of the eye-lid; and to two experiments detailed in my first Memoir, § 36, 42, in which the touch of the border of one eye-lid induced the firm and simultaneous closure of both.

282. But the most remarkable circumstance connected with the closure of the eye-lid is its relation to the state of *sleep*. I have already stated, § 106, 122, that the cerebral system alone undergoes this remarkable modification; that the true spinal system does not sleep. There must be some remarkable reciprocity between the levator palpebræ and the orbicularis in reference to this phenomenon. When awake, the levator palpebræ is more powerful than the orbicularis; in sleep, the action of the orbicularis prevails. I believe the levator palpebræ, and perhaps the four *recti* of the eye, to be, of all the muscles of the animal frame, the most purely *cerebral*, or *voluntary*, and unendowed with fibres from the excito-motory system. When awake, volition raises the eye-lid. During sleep, the excito-motory property induces constant contraction of the orbicularis, as it does of the other sphincters. The eye is thus preserved from exposure during the night,—preserved from the state of inflammation with which it is attacked, when, from injury of the facial nerve, or failure of the excito-motory power, the tonic influence of the medulla is cut off, or diminished, and the action of the orbicularis is defective. See § 36. Similar observations apply to the action of the recti, compared with the trochlearis and abducens.

II. *The Closure of the Larynx.*

283. The larynx closes accurately in every act of deglutition and in every effort to vomit,—on the contact of a drop of water or of a crumb of bread,—on attempting to inspire carbonic acid*, and in the case of ordinary choking.

284. If, in a living animal, or in an animal deprived of the cerebral lobes, the rima glottidis be touched with a feather or probe, the glottis immediately closes firmly. This phenomenon ceases instantly, in the latter case, on separating the larynx from its connections with the medulla oblongata

* Pilâtre de Rosier, in the Journal de Physique, xxviii, p. 422. Sir Humphry Davy, in his "Researches," p. 472.

by a sharp instrument, within or without the spinal canal, or on destroying the medulla itself. It is, therefore, plainly dependent upon the medulla and upon excitor nerves which proceed to, and motor nerves which proceed from, this part of the nervous system. It is a reflex, excito-motory act of the superior laryngeals and the medulla oblongata.

285. Legallois performed a series of original experiments on this subject. He arrived at the conclusion, that in an animal in which the pneumogastric nerves are divided in the neck, there is closure, more or less complete, of the glottis. He observes—" L'affection du larynx se propage par les nerfs récurrens, en sorte que la section de ces nerfs suffit pour la produire. Cette affection ne consiste pas seulement dans l'altération de la voix, mais encore dans une diminution de l'ouverture de la glotte. L'un et l'autre de ces effets sont dus à la paralysie des muscles aryténoïdeins, lesquels laissent retomber les cartilages aryténoïdes vers la glotte, ce qui relâche les ligamens de la glotte et les rapproche en même temps ; et toutes ces parties restent immobiles dans cet état*."

286. M. Magendie has written expressly upon the actions of the larynx ; and though he concludes from experiment and dissection, that the closure of the larynx depends upon the superior, and its opening upon the inferior laryngeals†, and that it is essential that *all* be divided, in order that the larynx may remain open and immoveable,—yet he is perfectly silent upon the essential agency of the medulla oblongata in all excited actions of the larynx. Mr. Mayo ascribes the closure of the larynx from the contact of carbonic acid, water, or mercury, to " the close consent between the sentient mucous surface of the larynx and its muscle‡."

287. Recently, Dr. J. Reid has deduced, from a series of experiments, that " The superior laryngeals are almost entirely nerves of sensation, supplying the mucous surface of the larynx, and part of the pharynx, with sensitive filaments. The few motor filaments which they contain are distributed in and move the crico-thyroid muscles. The inferior laryngeal nerves are ramified in and regulate the movements of all

* Œuvres, p. 201.
† De l'Epiglotte ; Op. cit. p. 9, etc.
‡ Op. cit. p. 361.

the muscles attached to the arytenoid cartilages; viz. the *crico-arytenoidei postici* and *laterales*, the *thyro-arytenoidei*, and *arytenoidei*. The inferior laryngeals also furnish the sensitive filaments to the upper part of the *trachea*, a few to the mucous surface of the pharynx, and still fewer to the larynx. When any irritation is applied to the mucous membrane of the larynx, in the healthy state, this does not excite the contraction of the muscles which approximate the arytenoid cartilages, by acting directly upon them through the mucous membrane; but this contraction takes place indirectly, and by a reflex action, in the performance of which the superior laryngeals act as the sensitive or afferent nerves, and the inferior laryngeals as the motor or efferent nerves. It is also probable that those branches of the inferior laryngeal distributed in the muscular fibres of the *trachea* are motor*." In other words (I imagine), the superior laryngeals are, principally, the *incident, excitor* nerves; the inferior laryngeals, principally, the *reflex and motor*. According to this view, the following is the *Table* of the closure of the larynx: it must be compared with *Plate* IV, *fig.* 2.

TABLE OF THE CLOSURE OF THE LARYNX.

I. *The Excitor.*	II. *The Centre.*	III. *The Motor.*
The Superior Laryngeal.	*The Medulla oblongata.*	*The Inferior Laryngeal or Recurrent.*

288. The great *principle* which prevails through these and *all* the functions of this Class, is the *excito-motor* agency, and the *reflex* form.

289. I now proceed to treat of the most important function of the Class; viz.

III.—*Respiration.*

290. As the connecting link between the excitor and motor nerves, in other cases, has been neglected, so the first link, or the excitor nerve itself, has been overlooked in refer-

* Edinb. Med. and Surg. Journ. No. 139, for 1840, p. 61.

ence to respiration. Legallois*, Sir Charles Bell†, M. Flourens‡, Prof. Müller himself§, all agree in considering the medulla oblongata the *primum mobile* of respiration. I had myself adopted this view of the subject, up to the period of my writing my second Memoir‖. I have since ascertained that, not the medulla oblongata, but the pneumogastric nerve, is that primum mobile, as its excitor, in ordinary respiration, and the fifth and spinal nerves as its excitors in certain extraordinary circumstances. Sir Charles Bell views the pneumogastric nerve as that which combines the movements of respiration¶; whereas it is really the medulla oblongata which performs that office: so that, in the views of that eminent physiologist, the offices of the medulla oblongata, and of the pneumogastric nerve, have been inverted. In reference to the respiratory system itself of Sir Charles Bell, whilst I bear my willing testimony to the genius of its author, I must observe, that it is doubly defective: it is, in the first place, only a part—the motor part—of the entire respiratory system; whilst, in the second place, the entire respiratory system is only a part of a more general system—the true spinal, or excito-motory—the agent in all the acts both of ingestion and egestion, respiration itself included.

291. I may conclude this preliminary notice of the subject by the following brief table of the *respiratory nerves*. It consists of the *excitors* of respiration, in addition to the respiratory system of Sir Charles Bell.

TABLE OF THE SYSTEM OF THE RESPIRATORY NERVES.

I. *The Excitors.*
1. *The Trifacial,*
2. *The Pneumogastric,*
3. *The Spinal.*

II. *The Medulla oblongata.*

III. *The Motors.*
1. *The Spinal Accessory,*
2. *The Intercostal,*
3. *The Diaphragmatic,*
4. *The lower Spinal, &c.*

* Œuvres, t. i, pp. 64, 237.
† The Nervous System, p. 246.
‡ Du Système Nerveux, pp. 180, 184.
§ Handbuch der Physiologie, 331.
‖ See Memoirs, p. 5, &c.
¶ Nervous System, 1830, p. 46; and Mr. Shaw's Manual of Anatomy, 2nd edit. 1822, p. 305, note.

292. I must beg my readers carefully to compare this *Table* with *Plate* V.

293. That the respiration is a mixed function, and partly dependent on cerebral agency or volition, is shown by the effect of profound attention, sleep, stupor, the sinking state, &c. During attention or sleep, the respiration becomes irregular and audible; in stupor, it is noisy and stertorous; in the dying state, it is impaired and catching. In *all* these cases the respiratory movements are instantly improved by rousing the person to sensibility and acts of volition. The partial dependence of respiration on the excito-motory power is made manifest by the division of the pneumo-gastric nerves: the acts of respiration immediately become much less frequent, and, as M. Magendie expresses it,—" L'animal parait y donner une attention particulière*." It is *cerebral.*

294. From the multitude of opinions respecting the acts of inspiration, it will be sufficient to select three, to be noticed in this place.

295. First, Dr. Wilson Philip† and Mr. Mayo‡ consider the acts of inspiration as acts of volition, or of conscious effort.

296. Secondly, Dr. Bostock§, Dr. W. Philip‖, and M. Brachet¶ consider the acts of inspiration as dependent upon the pneumogastric nerves as nerves of sensation.

297. Thirdly, Legallois, Sir Charles Bell, M. Flourens, Prof. Müller, &c. regard the acts of inspiration as dependent upon the medulla oblongata as their *primum mobile.* See § 290.

298. It appears to me to be a sufficient reply to the opinion that respiration is an act of the will or of conscious effort, that it is repeated when the cerebral lobes, the seat of volition and consciousness, are removed, and when all indubitably spontaneous acts have ceased.

299. And it appears to be a sufficient reply to the idea that inspiration depends upon an uneasy sensation conveyed to the sensorium by the pneumogastric nerves, that it is repeated when these nerves are divided. Dr. Bostock** and Mr. Mayo†† speak of this act, and of the agency of the pneu-

* Précis de Physiologie, tome ii, p. 355. † On the Vital Functions, p. 190, &c.
‡ Op. cit. p 83. § Op. cit. II, p. 46. ‖ Op. cit. p. 268.
¶ Op. cit. p. 132. ** Op. cit. II, p. 46. †† Op. cit. p. 83.

mogastric nerves, as imperfectly understood. M. Brachet, speaking of the experiment in which the pneumogastric is divided, observes—" dans ce cas, il ne faut point attribuer la continuation de la respiration au besoin senti de respirer, mais à *l'habitude* que le système nerveux cerebro-spinal a contractée de faire mouvoir les muscles respirateurs*!" It is quite unnecessary to make any remark upon this opinion.

300. I must now make some equally brief observations upon the opinion that the medulla oblongata is the primum mobile of respiration. It is founded upon the facts that the cerebrum may be removed from above downwards, and the spinal marrow from below upwards, without suspending the acts of inspiration, if the medulla oblongata at the point of origin of the pneumogastric be preserved entire. Yet, as M. Flourens observes†, " La preuve évidente que ce n'est ni uniquement ni même précisément parcequ'elle est l'origine de la huitième paire, que la moelle alongée est le premier mobile de la respiration, c'est que les deux nerfs de la huitième paire peuvent être coupés, et la respiration (quoique dès lors gênée et laborieuse) n'en subsistera pas moins fort long-temps encore." From these several experiments, we should be apt to conclude, that neither the cerebrum nor the pneumogastric nerves are necessary for the acts of inspiration, since these acts are renewed when either is removed. The truth, however, is, that although the acts of inspiration continue without *either*, they will not continue without *both*. *Each* may be removed *singly ;* but *if both* be removed, the inspirations cease, as in the experiment of dividing the medulla oblongata at the origin of the pneumogastric nerves, an experiment hitherto unexplained. In fact, inspiration may be a voluntary act, induced by the agency of the cerebrum, the pneumogastric nerves being divided; or it may be an excited act, excited through the agency of the pneumogastric nerves, the cerebrum being removed. If, in this latter circumstance, the pneumogastric nerves be divided, the acts of inspiration cease! In this last fact we have, then, the proof that the medulla oblongata is not the primum mobile of res-

* Op. cit. p. 132. † Op. cit. p. 181, note.

piration; but that the pneumogastric nerve is that primum mobile, as an excitor of respiration, essential and necessary when the agency of volition, with its organ, the cerebrum, is removed,—an important conclusion, by which many difficulties, and an interesting question, are at once solved.

301. The acts of inspiration, then, are acts of the excito-motory, or true spinal, system. Ordinary inspiration is excited through the medium of the pneumogastric nerve, but regulated and controlled by volition. During sleep, and in coma, the influence of volition is diminished, or annihilated, and the respiration becomes audible, or even stertorous. Respiration is, therefore, as stated of old, a *mixed* function; as, indeed, are many of the acts of the excito-motory system, excited through particular nerves, but regulated or modified by volition.

302. This remark leads me to observe that the pneumogastric is not the only excitor of inspiration. Inspiration is equally excited through the fifth and spinal nerves; a fact proved by the familiar phenomena induced by dashing cold water upon the extremities of the former in the face, and by impressing the latter by a similar influence on descending into the cold bath. The first act of inspiration in the newly-born infant is probably excited through the medium of the fifth and spinal nerves conjointly, by the contact of the atmosphere; as the first acts of the expulsion of the fæces and urine are excited during the similar contact of the atmosphere with the extremities of the spinal nerves.

303. My friend, Dr. Heming, witnessed an interesting fact in proof of this opinion. The infant just born, and covered by the bed-clothes, did not breathe. Dr. Heming, after waiting a few seconds, proposed to himself to adopt some measure for this asphyxia, and lifted up the bed-clothes. The contact of the cool atmosphere instantly *excited* an act of inspiration! This view of the subject is confirmed by some facts in pathology, to be detailed shortly, and by some experiments.

304. 1. In the first place, if the pneumogastric nerve be laid bare in the neck of a donkey, and irritated by the forceps, an act of inspiration, followed by an act of deglutition, is actually and instantly excited. This fact is confirmed by Dr. J.

Reid's experiments, in the Ed. Med. and Surg. Journ. vol. xlix, p. 131.

305. 2. In the second place, we have to consider what is the stimulus or exciting cause of inspiration. I must here adduce the celebrated experiment of Hook, given in a very early volume* of the Transactions of the Royal Society, in which a stream of atmospheric air was driven through the trachea, the lungs, and incisions made through the pleura, in a living dog: the animal made no effort to inspire whilst this stream was continuous; but when it was interrupted, the efforts of inspiration were violent and convulsive. In other words, when the air respired was unmingled with the carbonic acid exhaled by the lungs, no act of inspiration was excited; but when it became charged with that gas, efforts at inspiration were immediately made. Is carbonic acid, then, in the *air-cells* of the lungs, and in contact with the fibrillæ of the pneumogastric nerves, the exciting cause of inspiration?

306. 3. Other facts confirm this idea. Dr. Faraday particularly mentions the fact, that the respiration can be suspended longer after repeated deep inspirations, by which the air of the lungs is completely renewed, than in ordinary circumstances†. Divers breathe less frequently in proportion as they breathe an atmosphere under augmented pressure, and consequently condensed, — the *proportionate* bulk of carbonic acid evolved being less speedily completed.

307. 4. Lastly, the number of respirations is gradually augmented, with gasping, as the proportion of carbonic acid in a given quantity of gas, in which an animal is confined, becomes augmented. It would be interesting to repeat this experiment, taking the precaution of keeping the proportion of the oxygen gas the same. In a word, what pure carbonic acid is in contact with the rima glottidis, diluted carbonic acid is in the lungs;—an exciting cause acting through the medium of the excito-motory, or true spinal, system.

308. 5. This principle is corroborated by a circumstance, of which it alone affords an explanation. It has been observed that there is always a certain proportion maintained

* Phil. Trans. for 1667, p. 539.

† The London and Edinb. Phil. Mag. vol iii, 1833.

between the number of pulsations of the heart, and of respirations. This proportion obtains from the highest degree of activity in an animal, even to the most complete quiescence in hybernation. The evolution of carbonic acid is greater in proportion to the rapidity of the circulation: this carbonic acid is itself the exciting cause of inspiration; this act will, therefore, be repeated more or less frequently as the circulation, and with it the evolution of carbonic acid, is more or less rapid. I believe this law of the ratio observed between the circulation and the respiration has not been explained before.

309. 6. But the experimentum crucis consists in first carefully removing the cerebral lobes with the cerebellum, and then dividing the pneumogastric nerves within the cranium or spinal canal, or in the course of the neck. Respiration subsists as a purely excito-motory act, performed through the agency of the pneumogastric nerves, when the cerebrum is removed; and it ceases immediately when these nerves are then divided. See § 300, and compare the experiments of Dr. J. Reid, in the Edinb. Med. and Surg. Journ. vol. 1, p. 15.

310. It appears, from these various facts, that the acts of inspiration are excited acts, and excited through the medium of several excitor nerves. These may be arranged thus:

1. *The Trifacial.*
2. *The Pneumogastric.*
3. *The Spinal.*

But if these constitute the *excitor* nerves of inspiration, the medulla oblongata must be viewed as the organ which *combines* the various muscles into a system, and the various nerves comprised in the respiratory system of Sir Charles Bell are the true *motor* nerves of respiration. I may take this opportunity of remarking that, beautiful as it is, Sir Charles Bell's system of respiratory nerves is defective from *two* circumstances: first, it is confined to the motor nerves, of the respiratory system; secondly, it is confined to respiration, when it ought to be extended to the whole of that system which I have ventured to denominate excito-motory, and which relates, not to respiration alone, but to all the acts of ingestion and egestion. See and compare *Plates* I and V.

311. In the separated head of the turtle, an act of respiration is excited either by irritating the nostril, the larynx,

or the cut surface of the spinal marrow. The action is alike—equally excited—in all. In the dragon-fly, each ganglion appears to be an analogue to the medulla oblongata. See *Plate* V, *fig.* 2 *and* 3. But this subject is reserved for my quarto volume.

IV.—*The Act of Deglutition.*

312. The next part of the physiology of the true spinal marrow, and of the excito-motory system of nerves, relates to the act of deglutition. In treating of this subject, I must speak principally of the action of the pharynx, but also of that of the œsophagus and of the cardia.

313. 1. *Action of the Pharynx.*—If we press down the tongue with the handle of a spoon, and convey the instrument towards the root of the tongue and tonsils, an action of deglutition ensues*. If, in a living animal, an incision be made in the side of the neck, and the finger be passed into the pharynx, it is immediately grasped forcibly†. The same event occurs even after decapitation in a young animal‡. In this last case, the action ceases either on dividing the nerves which intervene between the pharynx and the medulla, or by removing the medulla itself.

314. I have looked over the popular works of Dr. Bostock, M. Magendie, and Mr. Mayo, for any intimation of the real nature of the action of deglutition, and of its dependence on the medulla spinalis, in vain. The first of these authors is entirely silent on the subject. The second observes, " Ainsi s'accomplit le deuxième temps de la déglutition, par l'effet duquel le bol alimentaire parcourt le pharynx et s'engage dans la partie supérieure de l'œsophage. Tous les phénomènes qui y co-opèrent se passent simultanément et avec une grande promptitude: ils ne sont pas soumis à la volonté; ils diffèrent donc, sous plusieurs rapports, des phénomènes qui appartiennent au premier temps§." Mr. Mayo speaks of " the peculiar sensibility of the back part of the fauces" as being " excited," and of the act itself as being " instinctive and irresistible‖" Mr. Mayo adds¶—" If the action of de-

* Mayo, Op cit. p. 112.
† Magendie, de l'Usage de l'Epiglotte, dans la Déglutition, p. 3.
‡ Müller, Op cit. p. 696.
§ Op. cit. II, 68.
‖ Op cit. 113.
¶ Ibid. p 114.

glutition be voluntarily performed several times in succession, and nothing but saliva swallowed, the parts become *fatigued*, and the operation cannot be immediately repeated." The real explanation of this last singular and interesting fact is this: an excited act requires a stimulus or excitor; the saliva is that stimulus in the first and second acts of deglutition; but in a third, attempted promptly after the second, this stimulus is wanting; the act consequently fails for want of its excitor. The idea of "fatigue" is obviously fallacious*.

315. In none of these authors is there the slightest allusion to the important and essential influence of the medulla oblongata in the act of deglutition.

316. I *must* adduce here an interesting fact from M. Flourens:

317 "J'ai dit ci-devant que l'animal privé de ses lobes cérébraux ne mange plus, même lorsqu' on lui met la nourriture sur la langue ou sur le bout du bec; et, d'un autre côté, j'ai dit qu'il avale parfaitement la nourriture qu'on lui enfonce dans la bouche. Ceci exige une petite explication.

318. "Lorsq'on met un grain de blé dans le bout du bec d'une poule, comme lorsqu'on lui met le bec dans l'eau, si elle happait le grain ou humait l'eau, ce serait une preuve qu'elle a *senti*, et qu'elle a *voulu*: aussi ne boit-elle ni ne mange-t-elle alors; mais au contraire, quand on lui verse l'eau, ou qu'on lui enfonce l'aliment dans le fond de la bouche, elle avale parceque l'action d'avaler, en soi, ne dépend, ni de la volonté ni du sentiment raisonné, et qu'il suffit qu'un corps touche le pharnyx pour qu'aussitôt la déglutition s'opère. Ce n'est donc encore ici qu'un mouvement commencé qui s'achève: il a commencé sans la volonté de l'animal, puisque c'est une main étrangère qui a porté l'aliment dans sa bouche; il s'achève sans sa volonté, puisque, en soi, le phénomène de la déglutition ne dépend pas d'elle†." No allusion to the influence of the spinal marrow!

319. 2. *Action of the Œsophagus.*—I formerly observed, —'The transition of the food over the glottis and along the middle and lower parts of the pharynx depends upon the reflex function: it can take place in animals in which the cerebrum has been destroyed‡, or the myo-glossal nerves

* See Memoir I, § 14, note 5; § 111. † Recherches, &c. p. 127. ‡ Ibid, p. 90.

divided*; but it requires the connection with the medulla oblongata to be preserved entire†; and the actual contact of some substance which may act as a stimulus‡: it is attended by the accurate closure of the glottis, and by the contraction of the pharynx. The completion of the act of deglutition is dependent upon the stimulus immediately impressed upon the muscular fibres of the œsophagus, and is the result of excited irritability.'

320. Prof. Müller§ and Dr. J. Reid have both pointed out the doubtful character of this conclusion. Dr. J. Reid observes—" The œsophageal filaments of the *vagus* are partly afferent and partly efferent nerves. In some animals, as in the rabbit, the section of the *vagi* in the neck is followed by arrestment of the passage of the food along the œsophagus, not from destroying the contractility of the muscular fibres of the œsophagus, but by breaking the continuity of the nervous circle necessary for the accomplishment of all reflex actions‖."

321. The power of deglutition, after the division of the pneumogastric nerves, varies much in different animals. In an experiment by MM. Leuret and Lassaigne¶ on the horse, seven pints of oats were eaten after the removal of five inches from each of the pneumogastrics; and in eight hours one half of this food was found in the stomach, and the other half in the small intestine. M. Dupuy's experiment was attended with a different result**. In the dog, deglutition seems perfect after the division of the pneumogastric nerves. But in the rabbit, as seen in the experiments of Sir A. Cooper, of Dr. J. Reid, and in my own, the food stagnates in the œsophagus.

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* See the Nervous System, by Sir Charles Bell, 4to edit. 1830. Appendix, p. cxviii, for the details of a most interesting experiment.

† De l'Usage de l'Epiglotte, par M. Magendie, Paris, 1813, pp. 6, 23, &c.

‡ This is the reason of our inability to perform the act of swallowing two or three times in rapid succession, without taking something into the mouth, or allowing time for the secretion of a portion of saliva. The reflex function must be excited into action by the contact of a stimulus. The act of swallowing cannot, therefore, be renewed, unless some substance, as saliva, be carried into contact with the pharynx. See § 313 and Memoir I, § 111, and Memoir II, § 144—.

§ Handbuch, p 697. Translation, p. 717.

‖ Edinb. Med. and Surg. Journal, for 1840, p. 61—62.

¶ Recherches sur la Digestion, p. 133.

** De la Fluxion Périodique, 1829, p. 125.

322. Still I think the conclusion of Dr. J. Reid, that œsophageal deglutition is entirely a reflex action, is incorrect; whilst my own first opinion was not altogether devoid of foundation. I found this opinion on the following fact:

323. After the removal of the œsophagus from the body of the rabbit entirely, in cases in which it remained replete with green food, I have observed a peristaltic movement which gradually expelled a portion of the food.

324. Œsophageal deglutition appears to me, therefore, to be partly of a reflex character, and partly due to the immediate excitement of the irritability of the muscular fibre. The *degree* in which these two functions operate, varies probably in different animals. Almost entirely excito-motory in the rabbit, œsophageal deglutition is, apparently, principally the result of excited irritability in the horse and dog. I propose pursuing this subject in my forthcoming quarto volume; in this, I must dismiss the subject of the physiology of the nervous system as briefly as may be convenient.

325. 3. *Action of the Cardia.*—The cardia opens to receive the food from the œsophagus, and closes to retain it in the stomach. It is paralysed on dividing the pneumogastric nerves. In a rabbit in which this experiment is performed, the œsophagus is found replete with food, although it may not have eaten after the operation. This fact was first ascertained, I believe, by MM. Leuret and Lassaigne*. *I repeat, that the pneumogastric is pre-eminently the internal excito-motory nerve.*

326. There is a fact to which I now wish particularly to advert. There seems to be a property of actual, not to say *active*, dilatation, in the cardia, as well as in some other sphincters. If we irritate the fauces, and induce the first disposition to vomit, we may be perfectly conscious of an act of opening of the cardia; a portion of gas escapes and ascends the œsophagus. A *similar* event doubtless takes place during deglutition. In regard to the sphincters, it is plain that they have the *power* of dilatation: gas may escape from the intestine noiselessly, and the urine from the bladder without effort; events very different from that generally supposed, of

* Recherches sur la Digestion, p. 132.

the sphincters being overcome by an antagonist force. There is a fact of *practical* interest connected with this view: sometimes hæmorrhoids are protruded so that no force of pressure can replace them; but, by inducing the patient to make the effort usual in voiding the intestine, the sphincter relaxes positively, and the hæmorrhoidal tumor is returned with facility by gentle pressure. See hereafter, § 393.

327. The act of deglutition may be thus displayed in the form of *Table:*

TABLE OF THE ACT OF DEGLUTITION.

I. *The Excitors and Motors which* close *the Larynx.*

II.

I. *The Excitors*	II. *The Centre of Deglutition.*	III. *The Motors*
1. *The Glosso-pharyngeal ?*		
2. 1. *The Pharyngeal—*	*The Medulla oblongata.*	1. 1. *The Pharyngeal—*
2. *The Œsophageal—*		2. *The Œsophageal—*
3. *The Cardiac— branches of the pneumogastric.*		3. *The Cardiac— branches of the pneumogastric.*

III. *The Immediate Excitors of Irritability in the Œsophagus.*

IV. *The Excitors and Motors which* open *the Cardia.*

328. This *Table* must be most carefully compared with *Plate* IV, *fig.* 3, and with the remarks in § § 283—; 304—. I have noticed in this table the nerves of the excited closure of the larynx, which is essential to deglutition. I have insisted on the active and positive opening of the cardia—a subject admitted to be obscure, and proposed for new investigation.

V.—*Closure of the Sphincter Ani.*

329. The sphincter ani and cervix vesicæ present precisely similar phenomena with the larynx and pharynx. In a horse, rendered insensible by a blow of the poll-axe, the sphincter was immediately forcibly contracted, and the tail raised, on stimulating the border of the anus; these phenomena ceased either on separating the sphincter from its connexion with the spinal marrow, or on destroying the spinal

marrow itself: the excitor and reflex action performed through the medulla, and the influence of the latter on the sphincter, are therefore obvious. Dr. Alison describes the action of the sphincters, in one work*, as dependent upon what he designates tonicity, a property of the muscular fibre; in another†, as belonging to the class of sympathetic actions. It is plain, from this discrepancy of opinion in the same author, that there was nothing definitive in our knowledge on this subject, until I proved that the action of the sphincters, like that of the orifices, depends on the excito-motory property, acting through incident, excitor nerves, the spinal marrow, and reflex, motor nerves.

VI.—*Action of the Expulsors.*

330. If, in a turtle, after the removal of the tail and the posterior extremities, with the rectum, and of course with a portion of the spinal marrow, water be forced into the intestine, by means of Read's syringe, both the cloaca and the bladder are fully distended before any part of the fluid escapes through the sphincter, which it then does on the use of much force only, and by jerks. If, when the cloaca is distended, the integuments over it are stimulated, the water is propelled to a considerable distance. The event is very different on withdrawing the spinal marrow: the sphincter being now relaxed, the water flows through it at once, in an easy continuous stream, with the application of little force, and without inducing any distention of the cloaca. The action of the sphincter and of the expulsors of the cloaca in the turtle, and its dependence on the spinal marrow, are distinctly proved by this interesting experiment.

VII.—*Acts of Generation.*

331. Erection of the penis is an excito-motory act. It was induced in patients with injury or disease of the spinal marrow, whose cases were observed by Dr. Macartney and Sir Benjamin Brodie, each time the catheter was introduced into the urethra; the patients themselves being unconscious either of the contact of the instrument or of its effect.

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* Outlines of Physiology and Pathology, Edinb. 1833; p. 7.

† British and Foreign Medical Review, vol. iii, p. 33.

332. That the emission of semen depends upon the same excito-motory function of the spinal marrow is equally obvious. In ordinary circumstances, it is excited through the influence of the nerve termed the dorsalis penis. It has been excited, in experiments made by M. Segalas, by acting immediately on the spinal marrow. " Si sur un cochon-d'Inde mâle, dont on a mis le cerveau à nu, dit ce physiologiste, on plonge un stylet dans le cervelet *de manière à arriver à la partie supérieure de la moelle de l'épine*, on produit *l'érection ;* si l'on pousse ensuite le stylet dans la colonne vertébrale, jusque dans la région lombaire, *l'éjaculation* a lieu, tandis que la vessie, fût-elle pleine, n'en conserve pas moins son dépôt. Les mêmes phénomènes s'observent dans les cochons-d'Inde décapités, quand on agit de même avec un stylet de haut en bas sur la moelle de l'épine*." This fact is confirmed by a remark of Mr. Earle and others,—that priapism exists in injury of the spinal marrow only when that injury is in the *neck.*

333. We owe to M. Brachet the account of two interesting cases bearing on this subject: 1. " M. de M— , après un service militaire de plusieurs années, éprouva, en 1814 et 1815, quelques douleurs de rhumatisme qui se fixaient plus particulièrement sur la région lombaire. En 1816, il fit une chûte de cheval. Peu à peu, la paralysie des membres inférieurs et du quart inférieur de l'abdomen fut complète. Depuis huit ans cette paraplégie n'a fait de progrès ni en bien, ni en mal. Depuis qu'il est dans cet état, il a eu deux enfans. La sécrétion spermatique se fait très-bien ; l'erection a lieu, et l'éjaculation survient ; mais elle se passe sans secousse, et sans sensation†."

334. That the grasp of the Fallopian tubes is excited on the same principle is extremely probable ; and that the action of the uterus belongs to the same excito-motory system seems to be proved by the occurrence of the expulsion of the fœtus after the cessation of respiration. Such an event is noticed by Prof. Müller‡ ; and a recent case in point is given by Mr. Ingleby of Birmingham§.

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* Anatomie du Cerveau, par M. Serres, tome ii, p. 608.

† Sur le Système Nerveux ; 1830 ; p. 236.

‡ Handbuch, I. 696.

§ Obstetric Medicine, p. 44, 45.

335. A case is detailed, by M. Ollivier*, of paraplegia, in which parturition took place without difficulty. " Le 4 juin, à trois heures de matin, l'accouchement s'opéra tout à coup, et avec si peu de douleurs que la femme ne s'en aperçut que par la déplétion de l'abdomen et les cris de l'enfant, qui était vigoureux et pesait près de cinq kilogrammes." This paraplegia arose from the pressure of a tumor of acephalocysts extending from the fourth to the first dorsal vertebræ.

336. On the other hand, M. Brachet details a second case of paraplegia, in which parturition proceeded with extreme inertia. " J'ai connu une dame déjà mère de trois enfans, et qui devint paraplégique ; la perte de la sensibilité était complète jusqu'au dessus du pubis ; la sensation du coït fut anéantie, et cependant elle devint mère pour la quatrième fois. Après les neuf mois de grossesse, le travail parut s'établir, mais d'une maniére si vague qu'elle ne le soupçonna que par l'époque où elle se trouvait. A peine si l'utérus se tendait sous la main appliquée sur l'abdomen, il n'y avait point de douleurs. Par le toucher, je reconnus la même tension : l'orifice entr'ouvert était d'une mollesse remarquable ; les mucosités étaient abondantes. Je laissai la nature agir pendant vingt-quatre heures ; le travail ne s'établit pas mieux. Cette dame, qui se délivra très-vite dans ses deux dernières couches, désira la fin de son accouchement, dans la persuasion qu'elle ne se débarrasserait jamais elle-même. Par quelques titillations sur le col utérin, je tentai de provoquer les contractions. Ce fut en vain, cet organe souple se laissa distendre dans tous les sens, tellement, que l'orifice se trouva agrandi de toute la dimension possible. La tête de l'enfant se présentait bien. Je perçai la poche des eaux, le contractilité de la matrice les chassa ; la tête poussée, s'engagea au détroit supérieur, d'où elle ne bougea plus. Vainement, pendant deux heures je voulus solliciter l'accouchement naturel, en titillant et pinçant la matrice ; elle fut muette†."

337. M. Brachet has pursued the same subject experimentally ; but I reserve this part of the inquiry for my other work. (See p. 1, note.)

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* Traité de la Moelle Epinière, 1827, p. 784—792 ; compare p. 838.

† Op. cit. p. 253 ; 266.

338. I may now ask, how are we to explain the discrepancy between the facts—apparently similar—observed? I think it probable that, as in the case detailed by M. Ollivier, the disease was *above* the origin of the cauda equina; in that of M. Brachet, it was seated *below* that origin. In the latter case, the central or connecting link between the incident and reflex nerves would be wanting, and the reflex functions would consequently cease!

339. In this manner we observe, that whilst all the orifices of the animal frame, with the acts of ingestion, are under the influence of the reflex, excito-motory function of the spinal marrow, the sphincters and expulsors also act as parts of the same system. A plan of the nerves of this part of the system is sketched in *Plate* III, *fig.* 3.

340. It is plain that much of the science of *Midwifery* belongs to the subject of the true spinal system; and I doubt not that many improvements in this branch of medicine will result from our knowledge of this system. Inertia of the uterus may probably be remedied by some of the agents which operate upon the incident nerves, especially the impulse of cold water. I have witnessed the beneficial effect of dashing cold water over the hypogastric region in continued uterine hæmorrhagy. I knew an accoucheur who always applied a sponge of cold water to the face freely before proceeding to pass the female catheter, and sometimes with success. A similar impression of cold is known to move the bowels.

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341. I have hitherto treated of the excited *reflex* actions of the true spinal system; I now proceed to notice the *direct* action or influence of this (and of the ganglionic?) system: see Table, p. 55.

1. *The Irritability of the Muscular System.*

342. I have detailed a series of experiments, in some Memoirs published in the Transactions of the Royal Medico-Chirurgical Society*, which seems to prove that the irritability of the muscular fibre in the limbs depends greatly on the integrity of the spinal marrow. I performed the following experiments on six frogs:

* Vol. xxii, p. 191.

343. I divided the spinal marrow immediately below the origin of the brachial plexus; and I removed a portion of the ischiatic nerve of the right posterior extremity. I had immediately, or more remotely, the following interesting phenomena:

344. 1st. The anterior extremities alone were moved spontaneously; both posterior extremities remaining entirely motionless, when the animal, placed on its back, made ineffectual efforts to turn on the abdomen.

345. 2nd. Although perfectly paralytic in regard to spontaneous motion, the left posterior extremity, that still in connection with the spinal marrow, moved very energetically when stimulated by pinching the toes with the forceps.

346. 3rd. The right posterior extremity, or that of which the ischiatic nerve was divided, was entirely paralytic, both in reference to spontaneous and excited motions.

347. 4th. After the lapse of several weeks, whilst the muscular irritability of the left posterior extremity was gradually augmented, that of the right was gradually diminished, phenomena observed when the animal was placed in water, through which a slight galvanic shock was passed accurately in the direction of the mesial plane.

348. To these experiments I may add the evidence on this point afforded by the following *Case:*

349. On January the 16th, 1839, I visited a patient who had been seized with hemiplegia nine months before: the arm was perfectly paralytic, the leg less so, the face less so still. On passing the galvanic influence through the arms, the left or paralytic arm was much more affected than the right, and distinctly affected by a force which induced no effect whatever on the right, the tendons starting on each completion of the galvanic circle; the contraction of the muscles of the left side of the face was seen in its effect on the features; and that of the left gastrocnemius, in its effect on the tendo Achilles, when no effect was perceptible on the right side of the face, or in the right leg.

350. It is obvious then, that, both in the lower animals and in man, the integrity of the spinal marrow, and of its connection with the muscles of the limbs, is essential to that of their irritability.

351. The application of this fact to the *diagnosis* of the different cases of paralysis will be noticed hereafter.

352. I must add, that as the irritability of the internal organs doubtless depends much on the ganglionic system, so that of the muscles of the limbs may partly depend upon this latter system. Although I have observed the irritability to be *very greatly* diminished by the removal of the influence of the spinal marrow, I think I never knew it to be completely annihilated under such circumstances.

2. *The Tone of the Muscular System.*

353. There is another phenomenon belonging to this system which demands our attention,—the tone of the muscular fibre throughout the animal frame. Two rabbits were taken: from one the head was removed; from the other also the head was removed, and the spinal marrow was cautiously destroyed by a sharp instrument: the limbs of the former retained a certain degree of firmness and elasticity; those of the second were perfectly lax. The difference was most obvious. On the following day, the limbs of both were found equally rigid, from the contraction of the muscular fibre from its irritability.

354. The dependence of the muscles on the influence of the spinal marrow, for tone, is extremely obvious in the turtle.

355. The limbs and tail of a decapitated turtle possessed a certain degree of firmness or tone, recoiled on being drawn from their position, and moved with energy on the application of a stimulus. On withdrawing the spinal marrow gently out of its canal, all these phenomena ceased. The limbs were no longer obedient to stimuli, and became perfectly flaccid, having lost all their resilience. The sphincter lost its circular form and its contracted state, becoming lax, flaccid, and shapeless. The tail was flaccid, and unmoved on the application of stimuli.

356. It is perfectly obvious, from this experiment, that the tone of the muscular system, and the action of the limbs on the application of stimuli to the skin, are modifications of the same function. Both co-exist, or cease, with the spinal marrow.

Section IV.—*Some practical Applications of these Physiological Principles.*

357. I propose now to introduce to my readers a few singular and interesting *practical* applications of these principles.

1. *The Treatment of Choking.*

358. The first of these is the proper treatment of *choking*, arising from a morsel of food remaining in the pharynx. The *danger* arises not from mechanical pressure on the larynx or trachea, but from a reflex action closing the glottis. The remedy must be *immediate*. Now this is what should be done:

359. Pressure being made on the abdomen, to prevent the descent of the diaphragm, a forcible blow should be made by the flat hand on the thorax. The effect of this is to induce an effort *similar* to that of expiration; the larynx being closed, œsophageal vomiting takes place, and the morsel is dislodged.

360. If this plan fail, not an instant being lost, the pressure should be kept up on the abdomen, the finger should be introduced into the throat, and the same smart and forcible blow made on the thorax as before. By the irritation of the fauces, the cardia is opened (§ 325), and, by the blow on the thorax (firm pressure being made on the abdomen), an effort similar to that of expiration, with a closed larynx, is made, and a direct vomiting occurs, and the morsel of food is carried away. See hereafter, the section on *Vomiting*.

2. *The Mode of passing the Stomach-tube.*

361. It is often required to pass the *stomach-tube* in cases of *poisoning*. Now, in doing this, the great object is to avoid the *excitors of vomiting*. This is done by passing the tube boldly through the isthmus faucium,—avoiding touching the base of the tongue, the posterior gums, or the veil of the palate,—to the posterior part of the pharynx. In this last part, there are no nerves but those of the excitors and motors of deglutition; so that there is no difficulty in passing the stomach-tube, with these precautions, freely on into the œsophagus, and finally into the stomach itself.

3. *The Use of the Pharyngeal-tube.*

362. It has been usual, with the object of administering food, in cases of cut-throat, of mania, &c. also to introduce the tube through the whole course of the œsophagus into the stomach itself. It occurred to me, as a natural deduction from the physiology of deglutition, now ascertained to be a reflex *spinal* act, in the pharynx especially, that it was unnecessary to adopt this measure, and that to introduce a tube, which may be called the *pharyngeal-tube*, within the influence of the excitor nerves of deglutition, and within the grasp of the constrictors of the pharynx, would be sufficient. The interesting experiment was performed by Mr. Arthur Stilwell, of Moorcroft House, upon an insane patient, who had refused food, and had been fed by means of the stomach-tube, and whose case indeed suggested it. It succeeded as I anticipated.

363. In the case of poisoning, the *stomach-tube* itself must be used. In regard to this case, however, I beg to make one observation: frequently, patients make ineffectual efforts to vomit under the conjoint influence of an emetic and of a narcotic poison; if, in such a case, the stomach-tube be introduced, vomiting is frequently perfectly accomplished through the tube itself, and along its sides, from the influence of the tube on the excitors of vomiting, and, through them, on the cardia,—and the further operation of the syringe may be unnecessary. I need not state that the cases of severe poisoning will, however, require the syringe both for the injection and the extraction of fluids into the stomach.

364. Whether we use the *pharyngeal* or the *stomach-tube*, it is important that we should study the distribution of the excitor nerves. The branches of the trifacial nerve, distributed to (rather originating from) the soft palate, the posterior part of the gums, and (I believe) of the tongue, are the excitors of vomiting, and must be avoided. The branches of the glosso-pharyngeal or of the pneumogastric, originating from the pharynx, are the excitors of deglutition, and must be called into action. We must then pass the tube carefully through the isthmus faucium, and boldly carry it to the posterior part

of the pharynx. In this manner, every difficulty is avoided, and the operation is the simplest possible.

374. But it is generally necessary in the insane to open the mouth, and to retain it open by force. To avoid this necessity, I propose to introduce a smaller tube along *the floor of the nostril;* in doing this, we pass it *below* the nasal branches of the trifacial, which are the excitors of sneezing, and *above* the palatine branches of this nerve, which, as I have stated, are the excitors of vomiting. See *Plate* IV, *fig.* 5.

375. This suggestion was also adopted by Mr. Arthur Stilwell. A long, narrow, flexible tube, of the diameter of a large male catheter, was employed. It was passed just seven inches through the nostril, being incurvated towards the pharynx. The patient appeared entirely unaffected by the procedure. The fluid food was then propelled along the tube. Deglutition took place regularly, marked by the usual movements of the larynx: in vain did the patient try to expel it; saliva only appeared at the lips; the food had passed beyond the domain of *volition;* it had been seized by the actions of the excito-motory power. It passed freely onwards into the stomach!

4. *On Irritation of the Fauces, to induce Vomiting.*

376. From an ignorance of the physiology of these parts, a singular event has occurred. A patient wishing to excite vomiting, has introduced a feather,—too far,—*beyond* the excitors of vomiting, which he ought to have stimulated to their proper action, *to* the excitors of deglutition, under the influence of which the feather has actually been swallowed!

377. Two cases of this kind are recorded in the "Medical Observations and Inquiries," vol. iii, p. 7, and vol. vi, p. 231. I shall extract from these such passages as illustrate our present subject; and I have thought it well to insert a sketch of the feather itself, copied from the original plate (see *Plate* IV, *fig.* 6), in order that the eye and the memory may be impressed by the interesting and not unimportant fact:

378. The first case is by Dr. Cleghorne: "A young lady had the misfortune to swallow a feather, which she had thrust down her throat to provoke vomiting.

379. "The by-standers made several attempts to extract it

with their fingers; but, these not answering expectation, she drank warm water, and vomited plentifully, without discharging the feather. Then they sent for Mr. Morris, surgeon, who, being made acquainted with the circumstances of the case, did me the favour to call at my house and desire my assistance on this pressing emergency.

380. "As it was the third or fourth feather of a goose wing, whole and entire, without any part being cut off, we both agreed that all possible means ought to be employed without delay to extract it, as fatal consequences were to be apprehended from so stubborn and indigestible a body getting into the stomach: and, having mentioned the sponge and whalebone among the instruments we might have occasion for, Mr. Morris objected, that this would more probably push it down than bring it up; but he immediately retracted his opinion when I observed to him, that, the largest end of the shaft being uppermost, the slanting position of the *laminæ* composing the web might readily allow the instrument to pass beyond them, and catch hold of the sponge as it was drawn back again, more especially if the sponge was introduced dry, and permitted to swell by imbibing moisture in the *œsophagus*.

381. "After having considered the affair attentively, we went to our patient's lodging, furnished with all the proper instruments we might possibly stand in need of, and particularly with a long flexible whalebone, to each extremity of which a piece of sponge was fixed, with two strings reaching betwixt each. The strings were added to the instrument by Mr. Tuckey, some years ago, when he had occasion to use it, that he might have it in his power to extract the sponge, in case it should break loose from the whalebone in the *œsophagus*; and we readily perceived they might be of singular service in the present case, by laying hold of the web, if the whalebone was turned round its *axis*.

382. "We found our patient not very clear in her senses, so that she was incapable of giving a distinct account of what she felt. Nevertheless, she complained of an uneasiness in the right side of her neck below the *larynx*, though she drew her breath easy, and swallowed without any great difficulty.

383. "We first tried, by depressing the root of the tongue and inspecting the *fauces*, if we could see any part of the

feather, or reach it with our fingers; but, this being to no purpose, Mr. Morris introduced the smallest end of the above-mentioned instrument into the left side of the *fauces*, to avoid pushing down the feather, which we had reason to think was lodged in the right side of the *œsophagus*; and, having thrust it far down towards the stomach, he began to make the extraction by slow degrees, inclining the end of the instrument he held towards the left side, and twisting it round repeatedly, that the strings might have a better chance to take hold of the feather.

384. "This first attempt proved unsuccessful, and so did another which I made after the same manner; but the third time, Mr. Morris, having introduced the largest end of the instrument as far down as he could into the *œsophagus*, was lucky enough to bring up the feather along with it into the *fauces*, from whence he extracted it with his fingers, about two hours after it had been swallowed."

385. In a postcript, Dr. Cleghorne adds the following case from Gurischius: "A singing-master was long troubled with thick phlegm in the *fauces*, to remove which, he made use of a writing-pen, thrusting the downy part into his throat, and holding the shaft with his finger; one day the feather slipped down into the *œsophagus*, and could not be got up by all the attempts he could make. A surgeon, having introduced an instrument, pushed it into the stomach, instead of bringing it up. There it occasioned a pricking pain, which distressed the patient five or six months; yet, in two years time, the pain ceased entirely, though it never was observed that any part of the feather passed by the *anus*."

386. The next case is addressed by Mr. King to Dr. Cleghorne: "I send you a feather or pen, twelve inches in length, which was fortunately extracted from the œsophagus of a man who had put it into his throat to excite vomiting, and had let it slip down. Late one night, in the month of September last, a servant of an eminent merchant in my neighbourhood brought me a note from his master, requesting I would try to relieve him from the distress he was in by swallowing a pen, which he could not by any means get up. Upon enquiring how this accident happened, the poor fellow told me, that, about twelve o'clock at noon, he grew very

sick in his stomach, with an inclination to vomit; and, to help him to puke more easily, he went into his master's counting-house, took a pen from the desk, and thrust the feathered end down his throat; that it had slipped from his fingers, and that he had tried in vain to get it up: that to help its passage downwards he had taken jalap and Glauber's salts in large quantities, and would have taken more, but the apothecary to whom he applied refused to give him more. These medicines had caused him to puke violently; and, in one of the efforts to vomit, he had felt the pen, but could not get a sufficient hold of it to bring it up. I first tried with my finger whether I could feel the pen, but I could not; so that I had no expectation of relieving him by forceps or any other instrument than the whalebone probe; and recollecting the one you used on a like occasion had strings through the sponge lest it might at any time fall off,—that you attributed your success to the strings entangling with the feather,—I put a thread through the sponge of that I was going to use, hoping I might be lucky enough to bring it up thereby. I then passed it into the fauces, and down the gullet, and twisting it to engage it with the feather, I drew it up, but without success. This operation so disturbed his stomach that he threw up a large basonful of its contents. When he had recovered a little, I made a second attempt, but with no better success. I then let him rest awhile. I then made a third trial, twisting the whalebone in putting it down, and while it was down, and drawing it gently up, keeping the sponge to the side where he said the feather lay. As soon as I had drawn the instrument out of his mouth, he hastily put his finger and thumb into his throat, catched hold of the pen, which he found had been raised high enough to afford him a gripe of it, and threw it on the floor."

387. A patient, wishing to avoid the taste of medicine, has, in like manner, passed a tea-spoon within the grasp of the constriction of the pharynx, and it has, like the feather, been swallowed.

5. *The Intraction of the Rectum-bougie.*

388. These are by no means solitary cases of this kind. The other extremity of the alimentary tube presents us with

a phenomenon of a similar character. The action of this part of the animal frame is highly peculiar: after the expulsion of its contents, the last intestine has, through the medium of the internal sphincter and the lavator ani, an inverted action; and an instrument, introduced for the purpose of relieving the intestine, has been suddenly grasped, snatched from the fingers of the operator, and drawn up into the rectum and colon! Such a case has been described to me by Mr. Perry. The following case occurred to the celebrated Scarpa.

389. "*Foreign Body introduced into the Rectum.*—A villager, aged twenty-eight, of a constipated habit, experiencing very acute pain after a longer constipation than usual, and finding all attempts at defæcation fruitless, introduced by the anus a long piece of reed, hoping thus to induce mechanically the expulsion of the matter accumulated in the intestine. In this he succeeded; but, in order to render the evacuation more complete, he again introduced the reed, and more deeply, so that it escaped from him and penetrated further. The attempt to withdraw it, only caused it to enter still further. He then made violent efforts in the hope of inducing its return; but in vain. Terrible pain soon ensued, and continued all night: the next day the patient was taken to the hospital. The surgeon in attendance tried in vain to reach the foreign body with the finger and with the bent forceps. He administered a purgative, which served only to increase the pain."

390. I add Scarpa's remarks; they will shew how little the subject was then understood:

391. "Physiologists entertain no doubt of the existence of the *peristaltic* action of the large intestine; the daily effects of purgative enemata clearly prove it: besides, we know that, in this portion of the alimentary canal, there are three fleshy bundles, extending from the rectum, their fixed point, to the cœcum and the base of the appendix cœci. But all authors are not equally agreed respecting the *anti-peristaltic* movement of this portion of the digestive canal. However, if the vomiting of fæcal matter did not sufficiently demonstrate it, the history just related would place this fact beyond doubt; for to this cause alone we can attribute the passage of the reed from the rectum into the left colon, and

from this portion of the intestine into the transverse colon. This fact seems to prove likewise another truth, no less important in practice, which is, that the large intestine has less functional relation with the stomach than the small intestine; for the subject of these observations only experienced a little nausea at intervals, and never vomited, notwithstanding the continued irritation of the large intestine caused by the progress of the foreign body which it contained; whilst quite the contrary is observed when the small intestine is the seat of the irritation: and those surgeons, who have observed much of hernia, can appreciate the value of this symptom, by the aid of which they discriminate whether the incarcerated hernia be formed by the small or by the large intestine*."

6. *Severe Pains in the Rectum, and its Remedy.*

392. There is a peculiar and severe pain of the rectum, which comes on in paroxysms, generally during the first sleep, and of which I have not seen any description in medical writings. It appears to me to depend on some hæmorrhoidal tumor, compressed by the action of the sphincter ani. The infallible remedy is—to rise out of bed, and to make a forcible and sustained effort to relieve the bowels. The changed position of the hæmorrhoid, under these circumstances of positively relaxed sphincter, and effort of protrusion, leads to perfect relief of the paroxysm of pain.

7. *The Reduction of a Hæmorrhoidal Tumor.*

393. The last fact of this kind which I shall adduce, is one to which I have already adverted, § 326. Much difficulty has sometimes been experienced, not only by the patient, but by the surgeon, in returning protruding hæmorrhoids. Pressure alone is applied in vain. But if the patient be directed to make a forcible expulsive effort, and pressure be simultaneously made, the tumor frequently recedes immediately. The sphincter is positively relaxed; the ligature which it formed round the tumor is removed, and the reduction is easy.

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* Opuscoli di Chirurgia, vol. ii, and Archives Générales de Médecine, tome xii; Paris, 1826.

394. Would a similar measure aid the accoucheur in returning the prolapsed uterus?

395. Would a similar effort ever assist in the passing of the male catheter?

8. *Intraction of the Female Catheter.*

396. Intraction of the rectum-bougie is not the only fact of this nature. The female catheter has been suddenly drawn out of the fingers of the surgeon into the cavity of the bladder. The following most interesting case is extracted from the "Medical Facts and Observations," vol. i, p. 96; it occurred to Mr. Edward Ford, Surgeon to the Westminster Dispensary; I insert it entire from its practical value:

397. "Mary Wilding, a thin, delicate woman, about twenty-five years of age, was admitted in January last as a patient at the Westminster General Dispensary. She complained of a painful and involuntary discharge of urine, mixed with blood and matter, from the urethra; and also of a discharge of purulent urine, which was continually flowing from a fistulous sore, situated in the buttock, near the middle of the glutæus muscle. She was in a weak and emaciated state, and had been confined to her bed for several months; every attempt to move from thence being attended with most severe pains, both in the neck of the bladder and at the fistulous wound in the nates.

398. "Upon introducing a sound into the bladder, an extraneous substance was easily felt within its cavity; and, from its hardness, I judged that it might be a calculous concretion. At the patient's desire, I then proceeded to examine the fistulous sore on the buttock, and she told me there was a loose bit of bone in the wound, which frequently made its way outwards beyond the skin, but as often seemed to be retracted with considerable force. I found by examining it with the probe that it lay loose in the sinus, and I endeavoured to remove it with the forceps, gradually drawing it outwards. This process was not attended with much pain; but when the extraneous substance was brought forward about half an inch beyond the integuments, a further removal of it seemed impracticable, as it was strongly held back by the contraction of the muscles. Whilst it was retained externally by the

forceps, I viewed it closely, to ascertain whether it was an exfoliation of carious bone, or a calculous concretion, that had made its way outwards from the bladder, but was much astonished to find that the substance protruded from the wound was evidently the bulbous end of a silver catheter. This discovery instantly induced me to suspend any further operation, as it was clear that an attempt to remove the catheter, by extracting it forcibly through the wound, must occasion a considerable laceration of the fundus of the bladder; and I was anxious to collect from the patient such circumstances as might explain her unfortunate situation. She professed herself totally ignorant by what means the catheter had been lodged in her bladder, and could with difficulty believe the information I gave her. The narrative she furnished me with was, that she had been brought to bed four months; that, in the third month of her last pregnancy, she had been seized with a difficulty of voiding her urine, which had been several times drawn off by means of a catheter; that she had experienced great relief from this operation, but that the last time it was performed she had felt great pain, and had ever since been unable to remove from her bed without great distress; that she had been safely delivered at the expiration of the ninth month; and that she had since suckled her infant, though in the most wretched and debilitated state. It was obvious, from this account, that the catheter had escaped from the hands of the operator the last time the urine had been drawn off; that it had slipped into the bladder, and had been suffered to remain there; and that the only method of relieving her was to extract it through the meatus urinarius.

399. "From the weak state in which she lay, exhausted by suckling her infant, by pain, and by the discharge from the wound, I declined performing the operation till her health should be a little invigorated by weaning the child, and by a more nourishing diet. When this was accomplished, I was favored with the assistance of Dr. Jackson, Dr. Bland, and Dr. Combe, all of whom were anxious to see so singular a case.

400. "The patient was laid upon a table, and secured in the manner usually adopted in the operation of Lithotomy. The urethra was dilated by the blunt gorget introduced upon a

female staff, and the catheter was then attempted to be taken out by the forceps. This part of the operation was attended with much difficulty, as the catheter lay transversely in the bladder, the handle of it resting on the arch of the pubis, and its other extremity on the crura ischii. It was dislodged from its situation by drawing the blunt end outwards through the posterior wound, so that the handle of the instrument, being detached from the pubes, was more easily brought forward through the opening in the urethra, and extracted. The catheter, which is now in my possession, was found covered with a slight incrustation. The operation was finished by extracting a few small calculi from the bladder. The patient was then put to bed, and the same regimen pursued as after cutting for the stone. A slight fever came on, but was apparently more owing to the state of her breasts, as she had just weaned her child, than to the operation. The fistulous opening on the buttock healed in a few days, the urine passing entirely through the natural passage; and in one month she was perfectly well. She now retains her urine, and suffers no inconvenience from this extraordinary calamity."

401. The catheter in question is now, by the kindness of Mr. Copland, in my possession.

402. The accident which has thus been described is by no means rare. Two cases have occurred in which my friend Mr. Toogood of Bridgewater was called upon to extract the female catheter from the bladder under these circumstances. The accident is to be ascribed to successive, simultaneous contractions of the cervix vesicæ and levator ani, excited through incident and reflex nerves, in connection with the spinal marrow.

403. The following extracts from Mr. Toogood's cases are full of interest: "During the last year, I was requested by a medical friend to meet him in consultation on a case where he had permitted a silver catheter to slip into a lady's bladder. The patient had had a few weeks previously a severe labour, producing paralysis of the bladder, and rendering the introduction of the catheter necessary night and morning. A few hours before my visit, her medical attendant, in attempting to draw off the water, experienced some difficulty, and, whilst making more pressure than usual, the catheter slipped into

the bladder. He immediately attempted to reach it with his dressing forceps, but failed.

404. "The following plan was then tried: a piece of sponge tent, somewhat longer than a female catheter, and of the size of the little finger, was passed into the bladder, without difficulty or giving pain, and allowed to remain eight or ten hours, during which time the water passed freely through it. At the end of that period it was removed, and the fore finger of the left hand passed readily into the bladder. The catheter was felt lying across, one end resting on the pubes, and the other imbedded in the folds at the back part of the bladder. There was considerable difficulty in bringing it into the urethra, which was effected by carrying the fore finger of the right hand into the vagina, and pressing the bladder backwards and upwards, which brought that part of the instrument lying over the pubes within reach of the other finger, and then into the urethra, from whence it was readily removed by the dressing forceps. All this was effected with very little pain, and without the patient or her friends even being aware of what had happened. The instrument, which was one of the sliding short catheters recommended by Mr. Jewel, remained in the bladder fifteen days, producing but very slight irritation.

405 "This is, I believe, a very rare accident; and, on looking at the catheters which are generally in use, one only feels surprised that it does not happen more frequently, as there is not sufficient guard to prevent it. Mr. Abernethy used to relate in his lectures a case of this kind, where the catheter was not extracted; and a long time afterwards an abscess formed in the side, which was opened and discharged freely for some days; when, on passing a probe, a hard substance was felt, and extracted with a pair of common forceps, which proved to be a catheter.

406. "Sir Astley Cooper, lately, obligingly shewed me a drawing of a calculus, formed over a catheter, which had got into the bladder, and which he removed by the usual operation, some years since, at Guy's Hospital. To this gentleman I am indebted for suggesting the plan which proved so successful in this case*."

* Medical Gazette, vol. xii, p. 837.

407. " In your journal for September last*, I related the history of a case in which a female catheter had accidentally slipped into the bladder, where it remained fifteen days, without occasioning much irritation, when it was removed by dilating the urethra with a sponge tent. It is rather singular that another case of the same kind should so soon have fallen under my observation.

408. " Elizabeth Creed, aged twenty, married about four months, had retention of urine, and was relieved several times by the catheter, when, in passing it one day, it unfortunately slipped from the surgeon's fingers into the bladder. No attempt was made to extract it, and about a fortnight afterwards she was brought, from a distance of thirty miles, to the Bridgewater Infirmary. Having ascertained the presence of the instrument, I introduced a piece of sponge tent, in the evening, into the bladder, and allowed it to remain during the night. On the following morning I withdrew the sponge, and passed my finger, with some difficulty, into the bladder, and felt the catheter resting on the pubes; from whence it was removed into the urethra, and readily extracted. In this case the instrument remained in the bladder seventeen days, and created considerable irritation. There was much greater difficulty in dilating the urethra in this case than in the former one, which occurred after delivery: in the latter, the urine passed involuntarily until the fourth day; but, in the former, the urethra regained its power immediately.

409. " Two such cases having been brought to my notice in so short a period, it would appear that this accident is not of such rare occurrence as is generally imagined; and, with the instruments usually employed, may frequently happen, from sudden shrinking, or change of the patient's posture. It may not, therefore, be amiss to caution my professional brethren against using the common silver catheters, which are rarely provided with guards. Of late I have preferred a long flexible catheter, which is more convenient, particularly in all cases where it is necessary to empty the bladder during labour†."

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* London Medical Gazette, vol xii, p. 837.

† London Medical Gazette, vol. xiv, p. 636.

410. A similar accident, no doubt, occurred to the subject of the following case, for which I am indebted to Mr. Stafford:

411. "In the year 1825, a woman, in President's Ward, St. Bartholomew's Hospital, was in the habit of voiding pins from the bladder, which caused a great sensation amongst several classes of people, who were acquainted with the circumstance, in London. At that period I was house-surgeon to the Hospital, and one night was sent for to see her. She had then passed eighty-seven by the urethra, and still said she had more. I introduced a very narrow pair of forceps into the bladder, the point of which struck against a calculus. I seized hold of it with the forceps and drew it out, and found it to be a piece of paper rolled up like a spill, about three inches in length, and around it was deposited a considerable quantity of calculous matter, and particularly at one spot, and thus a nucleus for a stone was formed. The preparation is in the Museum of St. Bartholomew's Hospital. I need not remark that this woman was an imposter, and had been in the habit of pushing the pins into the bladder by the paper."

Section V.—*The Pathology of the True Spinal System.*

412. In treating of the pathology of the true spinal system, we must begin by adverting to the limits and modes of action of the *vis nervosa* or excito-motory power discussed from § 192 to § 242 inclusive.

413. The abnormal and morbid actions of this power observe the same *laws*.

414. The morbid stimulus may act upon the incident, the central, the reflex part of the excito-motory arc or arcs, and produce corresponding effects,—corresponding diseases. To use words familiar to the physiologists of Germany, we have a class of centripetal, central, and centrifugal diseases; we may have centripetal, or central epilepsy, and we may have spasmodic tic, and other affections, from an affection of the reflex or motor nerves.

415. In this manner, *the Class of Spasmodic diseases* is sub-divided into *three* sub-classes, a division of the utmost importance in practice, and illustrated by the following *Table:*

TABLE OF THE PATHOLOGY OF THE TRUE SPINAL SYSTEM.

I. *Diseases of the Incident Nerves.*

I. 1. *Dental*, 2. *Gastric*, 3. *Intestinal* — *Irritation in Infants.*
- 1. *The Crowing Inspiration.*
- 2. *Strabismus, Spasm of the Fingers and Toes; Strangury; Tenesmus; &c.*
- 3. *Convulsion.*
- 4. *Paralysis?*

II. 1. *Gastric*, 2. *Intestinal*, 3. *Uterine* — *Irritation in Adults.*
- I. *Hysteria.*
- II. *Asthma.*
- III. *Vomiting; Hiccup; &c.*
- IV. *Epilepsy.*
- V. *Puerperal Convulsion; &c.*

III. *Traumatic Tetanus; Hydrophobia; &c.*

II. *Diseases of the Spinal Marrow itself.*

I. *Inflammation and other Diseases.*

II. *Diseases of the Vertebræ and Membranes.*

III. *Counter-pressure, &c. in Diseases within the Cranium.*

IV. *Centric Epilepsy, Tetanus, &c.*

V. *Convulsions from Loss of Blood; &c.*

III. *Diseases of the Reflex or Motor Nerves.*

I. *Spasm.*
1. *Spasmodic Tic.*
2. *Torticollis.*
3. *Contracted Limbs; &c.*

II. *Paralysis.*

416. In treating of this subject, I must first advert to the influence of dental, of gastric, of intestinal, and of uterine irritation, or of the irritation of a nerve itself (as in tetanus and in hydrophobia), in inducing their special morbid effects upon or through the true spinal system; the effects of gastric and bronchial irritation in inducing asthma, &c. I must next advert to the more immediate irritation of disease within the cranium and the spinal canal, in inducing spasmodic disease (a most important but intricate subject) as well as of disease of the true spinal marrow itself; and I must, in the third place, treat of the effect of cold and other morbific agents on the motor nerves themselves.

417. These cases are severally pourtrayed in the *figures* 6, 7, 8, of *Plate* III.

418. In these figures, a star and a line will be observed on the incident, the central, and the reflex parts of the true spinal system, respectively: the star represents *irritation*, the result of which is *spasm;* the line represents *destructive lesion*, the result being *paralysis*. And thus we see the practical application of our views to the diagnosis of these diseases; and I need not state, that on the diagnosis the treatment depends.

419. Of *figures* 9 and 10, the former denotes the *direct*,—the latter the *retrograde*,—course of the excito-motory influence along the spinal marrow, as observed in experiments in physiology, and in the effects of diseases and of remedies, and they disprove the idea of the excito-motory phenomena being restricted to *segments* of the spinal marrow, at least to *transverse* segments; and prove the existence of segments taken in a longitudinal direction.

420. Similar direct and retrograde actions along the spinal marrow are seen in disease: teething induces strangury and tenesmus; scybala or other morbid states of the contents of the intestine induce crowing inspiration.

421. Another view of the subject of the pathology of the true spinal system is not less interesting. What are the parts or organs physiologically connected with this system? the orifices, the sphincters, the organs of ingestion, of expulsion, of exclusion. Now these are precisely the parts and organs involved in the diseases of the true spinal system.

422. Let us examine the symptoms of epilepsy, of tetanus, of hydrophobia. They are affections of the very parts or organs to which I have adverted. Let us consider the multifarious symptoms and affections in hysteria; they are affections of the same parts and organs. The orifices, the sphincters, the organs of ingestion and of egestion, are precisely those affected.

423. The same parts are affected by *emotion*. An interesting parallel might be drawn between hysteria and emotion; hysteria is, indeed, greatly an affection of emotion. The same functions are affected in both; and both are, in reality, frequently blended together.

424. The great and important distinction between epilepsy and hysteria, between the different forms of epilepsy, and between the crowing inspiration and convulsion in infants, consists in the condition of *one* of the organs to which I have referred—*the larynx*. According as the larynx is open or closed, is the affection of a milder or more formidable character.

425. To me these views appear to possess a peculiar and extensive practical interest. They are displayed in the subjoined *Table*, or *parallel:*

PARALLEL OF THE PHYSIOLOGY AND SYMPTOMS.

	Hysteria.	Crowing Inspiration.	Epilepsy.	Tetanus.	Hydrophobia.
The Excitability.				*Undue excitability.*	*Excitability extreme.*
I. The Eye, the Face, *&c.*		*Strabismus.*	*Strabismus; contortion of the face; bitten tongue or lip; &c.*		
II. The Pharynx.	*Dysphagia.*			*Dysphagia; Pharyngeal spasm.*	*Suffocative dysphagia; pharyngeal and laryngeal spasm; &c.*
III. The Larynx.	*Globus; aphonia; larynx open.*	1. *Partial closure, with crowing inspiration.*	*Partial loss of voice.*		
IV. The Respiration.	1. *Urgent thoracic dyspnœa.* 2. *Respiration solely diaphragmatic.* 3. *Vomiting; hiccup; &c.*	2. *Total closure, with expiratory efforts.*	*Closure with expiratory efforts.*	*Dyspnœa; pain at the ensiform cartilage.*	
V. The Expulsors; Sphincters.	*Constipation.* 1. *Dysury.* 2. *Retention of urine.*	1. *Tenesmus.* 2. *Dysury.*	*Discharge of* 1. *Fæces;* 2. *Urine; or* 3. *Semen.*	*Constipation; contracted sphincter ani?*	
VI. The Muscular System.	*Convulsion; trismus; tetanus; contracted hands, feet, &c.*	1. *Contracted thumb, fingers, and toes.* 2. *Convulsion.*	*Convulsion.*	*Trismus; emprosthotonos; opisthotonos; &c.*	

The orifices and the sphincters, with ingestion and egestion, are pathologically affected.

426. In addition to those sources of disease of the true spinal system already mentioned, there are others of great practical interest, which I will notice briefly:

427. The undue or unduly diminished quantity of blood in the medulla oblongata induces spasm or paralysis. I must here advert to the subject of the mutual action of the nervous and vascular systems in loss of blood: delirium, and coma, and paralysis of a peculiar kind, occur from loss of blood; and hæmorrhagy is one of the causes of puerperal and other convulsions. The animal which dies from loss of blood, dies convulsed. The cause of this convulsion is the anæmious condition, not of the brain, but of the spinal marrow; this is ascertained in the sheep in the following manner:

428. *Exp.* The butchers usually divide the large vessels of the sheep, and the animal dies in the midst of convulsions. I begged that the spinal marrow might be first divided most completely, and then the blood be allowed to flow from the divided blood-vessels: again there were violent convulsions,—an event which could depend on the anæmious state of the spinal marrow alone, the influence of the brain having been removed.

429. I may in this place advert once more to the interesting experiments of Sir Astley Cooper: he observes—

430. "I tied the carotid arteries (in a rabbit). Respiration was somewhat quickened, and the heart's action increased; but no other effect was produced. In five minutes, the vertebral arteries were compressed by the thumbs, the trachea being completely excluded. Respiration almost directly stopped: convulsive struggles succeeded; the animal lost its consciousness, and appeared dead. The pressure was removed, and it recovered with a convulsive inspiration. It lay on its side, making violent convulsive efforts, breathed laboriously; and its heart beat rapidly.

431. In two hours it had recovered; but its respiration was laborious*."

432. The compression was repeated five times with the same effects. The want of the due supply of blood to the medulla oblongata induced convulsive actions.

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* Guy's Hospital Reports, vol. i, p. 465.

433. It has been ascertained, that, *in experiments*, lesions of the encephalon induce *paralysis only;* whilst lesions of the medulla oblongata and spinalis induce *convulsion* or *paralysis*, according to its severity. Hence it becomes an important question to determine the cause of convulsive affections in *disease* of the encephalon. This cause appears to be either irritation or counter-pressure: the former may act through the medium of the nerves distributed to the membranes,—as the recurrent of the trifacial of Arnold,—as in epilepsy induced by a spicula of bone; the latter is illustrated by the case of meningitis by Dr. Abercrombie, already quoted, in which the anterior fontanelle became prominent; pressure upon it induced convulsion.

434. As a final remark, I must mention the singular influence of the *passions* over these and *all* the functions of the excito-motory system. Sickness, panting, convulsions, relaxation of the sphincters,—these, and a thousand other affections of this system, are induced through the mysterious influence of disgust, fear, &c. Infantile convulsions and epilepsy are renewed by vexation, &c. Of all diseases, those arising from fright are, I think, the most formidable.

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435. I now proceed to treat of some pathological facts a little in detail.

436. Disease may take place in any of the three divisions of which the true spinal or excito-motory system consists: in the course of the incident, excitor nerves; in the spinal marrow, or centre of the system; or in the reflex, motor nerves. I shall very briefly adduce examples of each of these.

437. The action of disease, in the first of these cases, is incident, and either direct in its course, or from *above, downwards*, or retrograde, that is, from *below, upwards*. It always induces a *spasmodic* affection. The action of disease, or of the causes of disease, in the third, is, I believe, never retrograde, and may induce either *spasm* or *paralysis*.

I. *The Cynic Spasm.*

438. The first fact which I shall adduce in illustration of these principles, is one to which I have ventured to apply

the designation of the *Cynic Spasm;* for it is probably the σπασμος κυνικος of Hippocrates; and it is certainly allied to the Sardonic laugh. It is excited through filaments of the trifacial nerve (the "*nervi ethmoidalis ramus narium externus**," the "*nervi lateralis narum superiores et inferiores*†") ; these, when excited under particular circumstances, induce contractions of the levatores alæ nasi. In a patient in the deep coma of apoplexy, I pierced the skin on the cheek, the hand, the thigh, &c. with a pin; there was no manifestation of sensation—no motion whatever. I then touched the eye-lash and the *internal* nostril with a feather; this induced action of the orbicularis and levator alæ nasi: I then pricked the *exterior* part of the nostril with the pin; the action of the levatores was immediate.

II. *Sneezing.*

439. I need scarcely treat of the nature of sneezing. But I must produce the following interesting paragraph from M. Magendie. It will serve at once to demonstrate in what obscurity all those actions were, before the discovery of the excito-motory system, and to illustrate that system now it is known:

440. "Je pensai à couper les nerfs de la cinquième paire, de manière à ce que les animaux survécussent. Mais il était plus facile d'avoir cette idée que de la mettre à exécution. Dans leurs trajets sur la base du crâne, les nerfs sont accolés au sinus caverneux et à l'artère carotide interne. Cependant j'en tentai la section sur quelques lapins, et le hasard me servit assez bien pour que je réussisse sur plusieurs animaux à les couper des deux côtés sans produire d'accident grave. Je fis les mêmes tentatives sur de jeunes chiens, de jeunes chats, des cochons d'Inde; je pus aussi m'assurer qu'une fois les nerfs bien coupés, toutes les traces de l'action des odeurs fortes disparaissaient. Les animaux qui éternuent, se frottent le nez, détournent la tête quand on leur fait respirer de l'ammoniaque, de l'acide acétique, etc., restent impassibles après la section de la cinquième paire, ou bien ne manifestent que l'action des odeurs sur le larynx.

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* Arnold, Pl. viii, 26. † Ibid. ix, 5.

441. "Il résulte, ce me semble, de cette expérience, contre-épreuve de la précédente, que l'odorat, relativement aux odeurs fortes, est exercé par le branches de la cinquième paire, et que la première paire de nerfs ne partage pas cette fonction avec la cinquième*."

442. Here the effect of *odours* is manifestly confounded with that of *excitants* of the true spinal system.

443. One fact in regard to sneezing is singular. The actual sneezing may frequently be prevented, after the inspiration by which it is usually preceded has occurred, by forcibly rubbing the end of the nose, in the same manner as sea-sickness and asthma are relieved by the free exposure of the face and hands to the cold breeze.

III. *Crowing Inspiration. Plate* VI, *fig.* 1.

444. Through the medium of irritation of the trifacial nerve in the gums during dentition, of the pneumo-gastric in the stomach from undigested food, and of spinal nerves in the rectum, from the presence of matters too long retained, or morbid in themselves, physicians frequently observe attacks of crowing inspiration, threatening suffocation, or of general convulsion, separately or consecutively. As minor parts of this singular affection of the excito-motory system, we observe the thumb drawn to the junction of the first and second phalanges of the fingers, so as to form a cone, and the toes drawn towards the sole of the foot.

445. As a further proof of the practical utility of these views, I may add, that early and effectually to relieve the gums, and to guard the stomach and intestines, in reference to the respective sources of irritation in these organs, constitute the certain means, if early adopted and steadily enforced, of removing and preventing these dreadful attacks.

446. It is important to observe, however, that convulsions, and even the crowing inspiration, instead of having their origin in excitor nerves, may arise from affection of the centre of the excito-motory system. In a case of spina-bifida, related to me by Mr. Herbert Evans, of Hampstead, there

* Journal de Physiologie, tome iv, p. 172.

was a croup-like convulsion whenever the little patient turned so as to press upon the *tumor*. In the case of anencephalous fœtus, described by Mr. Lawrence, convulsion was produced on pressing upon the medulla oblongata. In a case of meningitis, given by Dr. Abercrombie, the anterior fontanelle became very prominent, and pressure upon it induced convulsion. In one case of crowing inspiration, I found induration of the medulla oblongata.

447. These remarks which I have made, in reference to convulsions in infants, are applicable to epilepsy. This disease arises from causes acting through the medium of the excitor nerves, upon the central part of the system, or the spinal marrow. In the former case, the cause is seated in the stomach, the intestine, the uterus, and acts through excitor nerves. In the latter, it is seated within the cranium or spinal canal. In all, it acts directly or indirectly on the spinal marrow, the mediate or immediate source of all convulsive diseases.

IV. *Certain Forms of Asthma.*

448. Allusion has already been made, § 283, to the result of an attempt to inhale pure carbonic acid gas. The larynx is instantly closed through the agency of the pneumogastric or internal excito-motory nerve. The same closure of the larynx takes place, on similar principles, from *choking*, § 358; the difference being the difference of the reflex arc.

449. The crowing inspiration in children has been aptly designated, by Dr. Burgess, *laryngeal asthma*. There is a pathological truth of much importance involved in this expression. It denotes that the crowing inspiration of infants, taken as a special disease, which it is, is, like ordinary or *bronchial asthma, a disease of reflex action.*

450. If, instead of carbonic acid, the powder of ipecacuanha, diffused in the atmosphere, be inhaled, it reaches the bronchia, and, acting there upon the excito-motory system, induces contraction of the bronchial muscles and tubes, and a peculiar form of asthma, impeding the acts of inspiration. Indigestible substances taken into the stomach, and fæculent matters retained in the intestines, induce, in a similar manner, but by dissimilar means, the same effect.

451. This subject is illustrated, in a singular degree, by the following case of *Asthma from the presence of a shot in the bronchial tube,* which occurred in the person, and is related in the words, of Dr. Nooth*:

452. " In the year 1797, whilst I was on duty at Quebec, I became subject to an asthmatic affection, that came on almost every day for some months. It was at first very slight, there being only a sense of weight and fulness on the left side of my breast, together with some little difficulty in breathing. These symptoms attacked me sometimes in the day, sometimes in the night, and frequently continued for two or three hours." " Having obtained leave of absence, I embarked about the end of July, 1799, for Great Britain." " Soon after my arrival in London, I went to the theatre. The evening was remarkably warm, and the house was unusually crowded. These circumstances rendered my respiration more than usually difficult, and produced a greater degree of irregularity in my pulse than I had ever before experienced. To these symptoms was superadded a more troublesome cough than had ever before occurred; and, at last, such a difficulty of breathing came on as obliged me to retire. On arriving at my lodgings, I found myself so extremely ill, that I went to bed with very little expectation of living till the next morning. During the night, my respiration was very laborious, and my cough so extremely troublesome, that I slept very little. In the morning, when I attempted to get out of bed, the cough came on with such violence, that after many severe fits of it, I was, through fatigue, obliged to throw myself on the bed with my face downwards. In this position I remained some time, coughing occasionally with great violence, and spitting from time to time a considerable quantity of phlegm into my handkerchief. Perceiving accidentally that there was something very hard in my handkerchief, I was induced to examine it; and, dividing it with my knife, I found it was a large shot, about the eighth of an inch in diameter. As the cough, soon after I had expectorated this foreign body, was somewhat less frequent and less violent, I began to dress myself, and in a short time became

* Trans. of a Society for the Improvement of Medical Knowledge, vol. iii, p 5.

so easy that I sat down to breakfast. The cough, however, remained for some days, and the quantity of mucous discharged was very considerable; but, in a short time, both the cough and spitting were greatly lessened, and in about ten or twelve days disappeared altogether. The sense of weight and fulness in my chest likewise went off, and my pulse became regular. From that time to the present I have felt no uneasiness similar to what I experienced before the discharge of the shot."

453. "Reflecting on the circumstances which have been related, it occurred to me, that the complaints in my chest must have arisen from the shot, and that this substance must have past unperceived through the glottis in the act of drinking. I can indeed now recollect, that, previously to my experiencing any uneasiness in my chest, I was one day seized, immediately after drinking hastily the last glass of a bottle of wine, with a convulsive cough, which I at the time considered to be occasioned by a drop or two of the wine that had, as it is usually said, gone the wrong way; and that for some days after the cough continued very troublesome."

454. There is a most singular difference between laryngeal and bronchial asthma: the former frequently leads to convulsion; the latter, I believe, never! What is the reason of this diversity? It is this:—In laryngeal asthma, the larynx, as in the most formidable kinds of epilepsy, frequently becomes closed completely, and the inspiration suspended, with all its terrific consequences,—consequences which occur, from a similar cause, in pertussis, and especially in strangulation. I shall have occasion, hereafter, to call my readers' attention to the similarity between epilepsy and strangulation. It is most remarkable. In both, the brain and the medulla oblongata are congested; in both, violent convulsions occur, with protrusion of the tongue, and expulsion of the fæces, urine, and semen,—variously, of course, in various cases.

455. A more interesting subject of inquiry does not exist. It is the fact of *closure of the larynx* which gives their formidable character to the worst kinds of the crowing inspiration and of epilepsy: the *crowing*, indeed, occurs, in both; the *closure* in the worst cases.

V. *The Act of Vomiting.*

455. A more familiar example of pathological excitement of the true spinal system is the act of vomiting. The trifacial nerve distributed upon the fauces, and especially the velum pendulum palati,—the pneumogastric in the stomach, the renal duct, and the gall-duct,—and spinal nerves in the rectum and uterus, are the several excitor nerves through the medium of which this act is excited. See *Plate* VI, *fig.* 1.

456. No subject illustrates the special function of the true spinal or excito-motory system so admirably as vomiting. It is singular that Prof. Müller, in his account of the actions of the pharynx, and of the sphincter ani, and of vomiting, does not once allude to these phenomena as being reflex and spinal; so little did this most acute physiologist understand of this subject before the publication of my researches. The same remark may of course be made relative to the works of Mr. Mayo, M. Magendie, &c.

457. I shall distribute my remarks on vomiting in the following manner:

1. *Of Vomiting, as a reflex, spinal, Action.*
2. *Of the Mechanism of Vomiting.*
3. *Of Œsophageal Vomiting.*

I shall begin, then, by treating of

458. 1. *Vomiting, as a reflex, spinal, Act.* Professor Müller speaks of the nerves of the pharynx as those through which vomiting may be excited. This is a mistake; it is through branches of the trifacial distributed to the fauces that this act is excited, on touching these parts with the finger, a feather, &c. This fact I have proved by experiment. A friend of mine touched the fauces with an ivory knife; it immediately induced an incipient act of vomiting. He then carried the knife backwards, so as to touch the posterior part of the pharynx; no effect whatever was induced. A feather carried further down, instead of inducing vomiting, has actually been swallowed.

459. The velum pendulum palati, and points on the anterior and posterior parts of the tonsils, are particularly excitable.

460. A singular effect is amongst the first phenomena

observed. The cardia opens distinctly, and a little gas escapes into the œsophagus. Then the larynx closes, and the other associated movements of vomiting take place.

461. A disagreeable object seen—certain emotions, the motion of a ship at sea, or of a swing—the last by a sort of contre-coup; a blow, or fall on the head, seem to act through the medium of the medulla oblongata.

462. In vomiting excited through the fauces, it is the trifacial which is the nerve of transmission; in vomiting induced by an emetic, by a renal calculus, or a gall-stone, it is the pneumogastric; and in the vomiting of early pregnancy or dysmenorrhœa, it is a spinal nerve which is the incident excitor nerve. All those nerves convey the excitement ultimately to the medulla oblongata. This combines the action of the nerves which regulate the aperture of the cardia, the closure of the larynx, and the acts of expiration; but of this I propose to treat, at some length, under the head of

463. 2. *The Mechanism of the Act of Vomiting.* Two opinions have divided physiologists respecting the mechanism of the act of vomiting. It was originally and long thought that this act consisted simply in a sudden and forcible contraction of the stomach itself. Afterwards Bayle and Chirac, and, more recently, M. Magendie, considered that the stomach is inactive, and evacuated by being subject to pressure by the simultaneous contraction of the diaphragm and abdominal muscles. It appears to me that neither of these opinions is correct. M. Magendie distinctly proves, by actual observation, and by the substitution of a bladder in the place of the stomach, that the contraction of this organ is not usually subservient or necessary to the act of vomiting. I refer to the interesting paper (Paris, 1813) of that eminent physiologist for the more full elucidation of this first question. I proceed to state such observations as appear to me to controvert the second, and to establish that view of this subject which I have myself been led to adopt. It is obvious, that if vomiting were effected by a contraction of the diaphragm, it must be attended by inspiration. If this were the case, the fluids ejected from the stomach would be drawn into the larynx, and induce great irritation,—events which have not been observed. These events are indeed effectually prevented

by an accurate closure of the larynx,—a fact observed in an actual experiment by M. Magendie, who makes the following observation: — "Dans le vomissement, ou moment au les matières vomies traversent le pharynx, la glotte se ferme très-exactement." It is astonishing that this observation did not lead its acute author to see that, under such circumstances, a contraction of the diaphragm, unless the thorax followed precisely *pari passu*, was impossible. Complete vomiting has been observed, too, in cases in which the stomach has entirely passed through a wound of the diaphragm into the thorax, and in which it could not, consequently, be subjected to the action of that muscle. In some experiments, vomiting was observed also to take place, although the diaphragm had been paralysed by a division of the phrenic nerves, or its influence subtracted by a division of its anterior attachments.

464. This view of the subject is still further confirmed by facts, which I now proceed to state, which prove that the act of vomiting is an effort, not of inspiration, but of expiration. This is obvious enough, indeed, on a mere observation of the state of the thorax and abdomen during vomiting. The larynx is evidently abruptly and forcibly closed, the thorax drawn downwards, and the abdomen inwards.

465. Such, indeed, appears to me to be the precise nature of the act of vomiting, in ordinary circumstances. The contents of the thorax and abdomen are subjected to the sudden and almost spasmodic contraction of all the muscles of expiration, the larynx being closed so that no air can escape from the chest, and the two cavities being made one by the floating or inert condition of the diaphragm.

466. The mere mechanism of the act of vomiting differs little, therefore, from that of coughing, by which, indeed, the contents of the stomach are frequently expelled. The larynx in the former is, however, permanently, in the latter only momentarily, closed; and there is, doubtless, a different condition of the cardiac orifice and of the œsophagus.

467. It appeared to me, from these views of this subject, that if an opening were made into the trachea, or through the parietes of the thorax, the effort of expiration constituting the act of vomiting would issue in expelling the air through these orifices respectively, and the evacuation of the stomach

would be prevented; and I determined to submit the fact to the test of experiment. I took a little dog, made an ample opening into the wind-pipe, and gave a few grains of the sub-sulphate of mercury: the animal soon became sick. The first efforts to vomit induced a forcible expulsion of air through the orifice in the trachea. These efforts soon became very violent, however, and the stomach at length yielded part of its contents. It was perfectly evident that the violent contractions of the abdominal muscles pressed upon the viscera of the abdomen, so as to carry the diaphragm upwards to its fullest extent, and at this moment vomiting was effected. The act of expiration was so forcible, that a lighted candle placed near the tracheal orifice was several times extinguished. In a second experiment, a free opening was made into the thorax between the sixth and seventh ribs of the right side. The lung collapsed partially only. During the first efforts to vomit, air was forcibly expelled through this orifice; the lung was brought almost into contact with it; the stomach was not evacuated; but, as the efforts to vomit became extreme, a portion of lung was driven through the thoracic opening with violence and a sort of explosion, and at the same instant the stomach yielded its contents.

468. These experiments appear to admit of only one explanation, of one conclusion,—that the act of vomiting is a forcible expiratory effort, the larynx being firmly closed, and the diaphragm perfectly inert. It must be regarded as singular, that M. Bourdon, by whom the action of the expiratory muscles, in their various "efforts," has been so well investigated, should have adopted other views of the act of vomiting.

469. It is not intended to state, that the act of vomiting is simply such as I have described. There are many facts which appear to show that the œsophagus is not without its share of influence in this act; and it is plain that the cardiac orifice must be freely opened; for mere pressure upon the viscera of the abdomen will not, in ordinary circumstances, evacuate the contents of the stomach. To effect this open state of the cardiac orifice, it is probably necessary that the diaphragm should, indeed, be in a relaxed, rather than in a contracted state.

470. A singular and interesting fact was noticed by M. Magendie, of which he has given no explanation. During the state of nausea which preceded the act of vomiting, in some of his experiments, air was drawn into the stomach. I am disposed to think that this effect was produced in the following manner:—The larynx being closed preparatorily to the act of vomiting, an attempt at inspiration is made before the effort of expiration. In this attempt, air is drawn into the œsophagus, the larynx being impervious, and it is afterwards probably propelled along that canal into the stomach itself. It is not improbable, too, that, in some instances of vomiting, in which the action of the abdominal muscles was subtracted, a similar effort of inspiration has drawn substances from the stomach into the œsophagus, which has eventually expelled them by an inverted action. Neither of these phenomena could result from any action of the diaphragm, and much less from contraction of the abdominal muscles; but it is easy, by closing the larynx and attempting to inspire, to draw air into the œsophagus. A similar act, if very forcible, might draw a portion of the contents of the stomach through the cardiac orifice.

471. Such then, I think, appears to be the nature of the act of vomiting. How different is this act from one in which the diaphragm does indeed contract suddenly under similar circumstances of closure of the larynx, viz. singultus, the action of the diaphragm being an effort of inspiration; air is apt to be drawn into the œsophagus with considerable noise, and there is occasionally pain, not only about the insertion of the diaphragm, but about the closed larynx.

472. Since the publication of the preceding remarks in the "Quarterly Journal of Science" for June, 1828, I have been greatly interested by the following extract from the valuable report of cases in the Meath Hospital, just published by Drs. Graves and Stokes, in the "Dublin Hospital Reports," vol. v.

473. "A man, about forty years of age, died of tubercular phthisis.

474. "The œsophagus, after passing through the usual opening in the diaphragm, was found to re-enter the thorax by another very large opening in the tendinous portion to-

wards the left side. The stomach occupied the inferior portion of the left thoracic cavity, its cardiac and pyloric extremities both lying in the opening.

475. " The man vomited frequently while under observation in the hospital. Now, as the stomach was placed entirely out of the reach of being compressed by the contractions of the diaphragm, and as this contraction completely defended it from the influence of the abdominal muscles, it is clear that, in this case, vomiting must have occurred independently of compression, either of the diaphragm or of the abdominal muscles. This fact, worth a thousand experiments, completely decides the question, that vomiting may be produced by the action of the stomach itself, unassisted by any external compressing force, notwithstanding what Legallois and late physiologists have said to the contrary."—p. 85—87.

476. The authors of the report do not appear to have seen the paper which I published in the number of the journal of the Royal Institution for April to July, 1828, the object of which was—first, to expose the fallacy, both of that view of the nature of the act of vomiting, which refers it to a contraction of the stomach itself, and of that other view lately advocated by M. Magendie, which refers this act to the simultaneous contraction of the diaphragm and abdominal muscles; and, secondly, to propose a new view of this disputed question. As this last view has never been controverted—as it has, on the other hand, been generally admitted, —and as it alone explains the various difficulties which beset each or both of the other two,—it may not be amiss to reproduce its broad outlines here, in connection with the interesting case of Dr. Graves and Dr. Stokes. They are these:— During the act of vomiting

1. The *larynx* is *closed;*

2. The *cardia* is *opened;* and,

3. All the muscles of *expiration* are called into action; but,

4. Actual expiration being prevented by the closure of the larynx, the force of the *effort* is expended upon the stomach, the cardia being open, and vomiting is effected.

477. A similar case is detailed by Dr. Bright, in " Guy's Hospital Reports," vol. i, p. 598.

478. It is plain, from this view of the subject, that the

thorax and abdomen become one cavity, as it were; the diaphragm lying loose and inert between them. It is also obvious, that it is quite indifferent on which side of the diaphragm the stomach may be placed; whether above, as in the case of hernia, or below, in its natural situation.

479. The view of the act of vomiting which I have taken, appears to me to be the only one which at once explains this act, as it occurs in the case of hernia of the stomach through the diaphragm, such as the one detailed by Dr. Graves and Dr. Stokes; and the experiment of M. Magendie, in which a bladder was substituted in the place of a stomach. The first establishes the fact, that the diaphragm—the second, that the stomach—has no necessary part in vomiting. It remained, therefore, to show in what other manner the act of vomiting, and both of these facts, would admit of explanation. This is done in the manner already detailed; and the truth of the explanation is proved by two decisive experiments, related in the paper to which I have already referred.

479. The next point I must treat of is that of

480. 3. *Œsophageal Vomiting.* I have recently had an opportunity of watching the effort to swallow and the effort to vomit in a patient with total obstruction at the cardia.

481. The effort to swallow was not to be distinguished from that in health; nor could the patient detect any difference, until, the œsophagus being completely filled, the fluid ceased to descend beyond the pharynx, and flowed out of the mouth. The effort to vomit was also perfectly similar to that which takes place in health; the larynx was closed, an effort of expiration was forcibly made, and the fluids in the œsophagus were expelled as in ordinary vomiting.

482. The stomach-tube was introduced repeatedly; whenever it reached the cardia, and so extended the œsophagus, an effort to vomit uniformly took place, as in the experiments of Legallois; at the same moment the fluids contained in the œsophagus were forcibly expelled through the tube.

483. The whole of the phenomena in this case afforded an interesting confirmation of the views I had published on the mechanism of the act of vomiting, in 1828. In ordinary vomiting, the abdomen and thorax become as one large cavity, the intervening diaphragm floating perfectly loose and

inert between them, whilst the cavity of the stomach and of the œsophagus become equally one by the free opening of the cardia; an *effort of expiration* then takes place, and the stomach is evacuated through the œsophagus.

484. I shall conclude this important subject by the following

TABLE OF THE ACT OF VOMITING.

I. *The Excitors and Motors which* close *the Larynx.*

II. *The Excitors and Motors which* open *the Cardia.*

III.

I. *The Excitors,*	II. *The Centric Organ, of Expiratory Effort:*	III. *The Motors,*
1. *The Faucial branch of the Trifacial.* 2. *The Gastric, Renal, and Hepatic branches of the Pneumogastric.* 3. *The Intestinal or Uterine branches of the Spinal nerves.*	*The Medulla oblongata.*	*The Spinal nerves distributed* 1. *To the Intercostal, and* 2. *To the Abdominal, muscles.*

This *Table* must be carefully compared with *Plate* VI, *fig.* 1, already noticed.

VI. *The Act of Generation; Conception.*

485. It is plain, from the circumstances, that the act of the συνουσια in the male sex is,—irrespective of the sensation,—one of the true spinal marrow; it is an *excited* act, from an appropriate stimulus. This being wanting, the *act* of ejaculation is as impossible as that of deglutition without saliva or other appropriate stimulus of the muscles of the pharynx.

486. Gregory, speaking of this act, observes,—"Ita ut totum genus nervosum mirum in modum convellat, musculosque *levatores ani* dictos ad contractionem cieat," &c. &c.—and adds,—"semen in urethram effusum novum dat stimulum cui musculus *accelerator* paret, in reddenda urina voluntarii motus, in expellendo semine inviti motus, organum," &c.

487. The same elegant writer adds,—" Neque solus accelerator musculus convellitur; levis plerumque tremor aut convulsio, aliquando vero vehementissima convulsio omnium musculorum in venere observatur; hinc anhelatio, palpitatio, syncope, *epilepsia* nonnunquam, vel demum subita mors, quæ nonnullos venere occupatos, nec tale quidquam timentes abripuit."

488. There is but a step from the normal affection of the nervous, muscular, and respiratory systems, in that circumstance, to an attack of epilepsy itself; Hippocrates is said to have observed,—*την συνουσιαν ειναι μικραν επιληψιαν.* On the other hand, there is, in epilepsy, as I have stated, frequently an action of the ejaculatores.

489. The whole of these phenomena lead us to interesting views, both of this act and of this disease. Both are, primarily, affections of the excito-motory system. A patient, mentioned by M. Brachet, as already mentioned, § 333, perfectly paraplegic, and destitute of all sensation below the loins, becomes a father; the *συνουσια* is described as being "sans sensation, sans secousse." Its influence was *limited* by the disease.

490. With these remarks I must conjoin one or two observations respecting the connection of the uterus with the excito-motory system. Every one is aware of the effect of conception in inducing vomiting, and of the fearful attacks of convulsion which sometimes supervene at a later period of pregnancy, and during, or after, parturition. One patient, on the other hand, subject to epilepsy, lost the attacks during the whole period of pregnancy. The very act of parturition, inscrutable as it is, seems, with abortion, to be one of the excito-motory system.

VII. *Morbid Susceptibility of the Ejaculatores Seminis.*

491. From personal abuse, from sexual excesses, &c. such a degree of susceptibility is induced in the ejaculatores seminis, that the slightest excitement, mental or physical, and even the evacuation of the bladder or rectum, induce seminal emissions, with a multitude of morbid effects, general or topical, and both of the nervous and other systems of the animal œconomy.

492. This subject is of intense interest, and of the most

delicate character. It may be treated physiologically and pathologically with great advantage to a class of patients who have long been the domain and dupes of unprincipled quacks and pretenders. One form of impotence, and one form of spinal disease, to be treated of hereafter, arise from these causes.

VIII. *Sterility; Abortion.*

493. Of all the facts in physiology or pathology, the nature of conception and the case of sterility are perhaps the most obscure. Excito-motory in its nature, conception involves the ingestion of the semen and the grasping of the ovum. Exhausted excito-motor power, structural defect, or pathological change, in the condition of the uterus or its appendages, may be the cause of sterility.

494. Abortion, on the other hand, may, like the case of morbid susceptibility and seminal emission, arise from undue excitability, and must be treated on the same principles.

495. How important this subject is in itself, how much it is in need of new investigation, how necessary it is to rescue it from the hands of the dishonest empiric, I need not say. The first step in the investigation is, to have traced the phenomena to their appropriate organ in the nervous system, and to their principle and mode of action. That that organ is the true spinal marrow, that that principle is the *vis nervosa* or excito-motor power, and that mode, reflex, are too obvious to need further proof. The phenomena may take place irrespective of the cerebrum; and are only dependent for the secretions required for them on the ganglionic system. They are in every respect similar to others indubitably excito-motory.

496. The uterine system is to the species, what the gastric is to the individual.

IX. *Tenesmus; Strangury; &c.*

497. The expulsors and sphincters of the animal frame are liable to similar affections. A minute calculus, situated high up in the urethra, has induced such contraction of the sphincter ani, as almost to close the canal. A ligature upon a hæmorrhoidal tumor has induced absolute retention of urine. A source of irritation within the rectum, or within

the bladder, frequently induces tenesmus, or strangury, or both. These phenomena are all induced through the spinal excitor and motor nerves. But a more extraordinary case of this kind is induced through excitor nerves more remotely situated. In a little boy, the nephew of Dr. Heming, strangury was induced, in the most unequivocal manner, by dentition. The case was supposed to be calculus. It was relieved at once by effectually lancing the gums.

X. *Failure of the Excito-motor Power.*

498. In cases of disease of the head, of exhaustion, of sinking—as the general powers of life decline, the gradual failure of the excito-motory power is particularly marked.

499. The first thing observed is, that the eye-lids do not perfectly close during sleep; they still, however, close on touching the eye-lash. In a short time, not only the continued action of the orbicularis is defective, but the excitability of the border of the eye-lid is impaired, and the orbicularis ceases to act on touching the eye-lash.

500. The second effect of a failing excito-motory power is an affection of the respiration. This is first *audible*, as in sleep. It then ceases to be *equable*, and at length consists in sudden, *catching* inspirations,—a state from which I never knew a patient recover.

501. In the next place, the sphincters lose their power.

Section VI.—*The Therapeutics of the True Spinal System.*

502. The fœtus in utero is so little exposed to the influence of stimulants or excitants applied to the cutaneous or mucous surfaces, that the excito-motory property is, *comparatively*, little called into action in the form of the reflex function. The contact of the liquor amnii may preserve the lips or the larynx, and the sphincter ani, closed. In this manner the reflex function, or the function of exclusion and of retention, is in activity; but, as the agent in ingestion and egestion, it is as if it did not exist.

503. It is on the expulsion of the fœtus, and by the contact of the atmospheric air with the minute origins of the incident nerves of the excito-motory system, that the functions of ingestion and egestion first commence.

504. It is, doubtless, from the impression of the atmospheric air on the trifacial and spinal nerves, distributed upon the surface of the face and body, that the first inspiration is excited. My friend, Dr. Heming, in attendance on a case of labour, waited, after the delivery of the child, for the usual sign of respiration,—crying. This did not take place; and Dr. Heming began to feel a little anxiety for the infant's safety. On the point of proceeding to the use of some means of resuscitation, he raised the bed-clothes, and of course admitted the atmospheric air into contact with the infant's skin. Inspiration was instantly excited, and the little patient continued to breathe.

505. The influence of cold water dashed on the face, and the influence of the diffused contact of the cold bath, in exciting sudden sobbing acts of inspiration, are well known.

506. The same contact of cold air which excites the first inspiration, also excites the first acts of suction and of expulsion of the fæces and urine. This effect is also seen in the later periods of existence. The cold bath induces the same effect. I have observed animals, on being driven through a cold stream, invariably to evacuate the rectum and bladder. Cold water, injected into the rectum, is sometimes expelled with force. The same effect was produced in one of Dr. William Budd's patients*, on injecting cold water into the bladder. Might not this remedy be used with advantage, both externally and internally, in lingering labour and uterine hæmorrhage?

507. Not only the bladder and rectum, but the uterus is subjected to the same influence. The catamenia are apt to be suddenly checked by the influence of cold. The uterus is excited to contraction, and uterine hæmorrhagy is most distinctly arrested, by an effectual douche of cold water.

508. I may here advert to the *diffused* influence of a mere *partial* application of cold upon the skin. The pores over an extensive surface are closed, and the perspiration arrested. Is this a *muscular* phenomenon, belonging to the reflex excito-motory system?

509. It is interesting to observe the salutary effects of the

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* Medico-Chirurgical Transactions, vol. xxii, p. 182.

new exposure of a fœtus at the precise moment when new functions are required. It is also interesting to observe the influence of the same cause at subsequent periods of life, and in certain cases of morbid affection. Of the latter, none are more remarkable than the phenomena observed in the coma of epilepsy and apoplexy. The medulla oblongata being compressed, together with the other contents of the cranium, the influence of dashing cold water on the face may be absolutely null: on taking off that pressure by bloodletting, the susceptibility to the influence is again restored: it becomes a measure, even, of the diminished compression.

510. There are other influences of cold, which must not be passed over unnoticed. Free exposure of the face to the cold breeze is the most effectual remedy in sea-sickness, and affords manifest relief in asthma.

511. As to other excitants of the reflex functions, we need only call to mind the simplest facts. The nipple or the finger, introduced between the lips of the new-born, or even the anencephalous, fœtus, immediately excites the act of sucking: the mere introduction of the enema pipe into the rectum of an infant, equally excites the action of the rectum. The irritation of a few grains of common salt, applied to the border of the sphincter ani, will induce the premature expulsion of an egg in a common fowl*.

512. I need scarcely allude to food as the natural excitor of the pharynx, œsophagus, and cardia, or to the fæces and urine as the equally natural excitors of the expulsors about the rectum, and of the bladder.

513. It will be observed that in *all* these cases the excitant is applied to *cutaneous* or *mucous* surfaces: these surfaces are, indeed, the only surfaces exposed to the action of external stimuli. Some internal textures are, however, capable of transmitting the influence of excitants. I have seen the limbs of the decapitated turtle moved energetically on dividing internal tissues Of this, too, the cases published in the twenty-second volume of the Transactions of the Royal Med. Chir. Society, p. 1, by Dr. R. Bright, may be examples.

514. It still remains for us to trace the influence of ex-

* The same effect is said to have been produced by the secale cornutum, in an experiment performed by M. Velpeau.

citants of this function in some more hidden cases. It is almost certain that the gall-ducts, the ureters, and other excretory canals, are endowed both with incident and excitor, and with reflex and motor, nerves. The passage of a biliary or urinary calculus *excites* vomiting: exposure to cold, a loaded intestine, certain passions, and in infants mere dentition, will, on the other hand, arrest the flow of bile and induce icterus.

515. The influence of the excitants of this system of actions, considered as *remedies,* is little known. One of the most interesting examples of this kind is that of the application of cold to the face and to the general surface, in some cases of suspended animation. As a remedy in the cases of the still-born fœtus and of drowning, the sudden contact of cold water is most important. I have already alluded to the use and influence of the cold-water douche in cases of hæmorrhage from inaction of the uterus.

516. Physiology is still in need of a series of experiments upon the comparative influence of the several excitants, especially cold, heat, and *mechanical irritation.*

517. It remains for me to observe what are the agents which most effectually excite the reflex actions in disease. A metallic spoon, taken out of cold or hot water, and suddenly applied, the pulling of a hair, the prick of a needle, the titillation of a feather, are the means which most naturally suggest themselves as tests of the excito-motory actions in cases of paraplegia.

518. The subject of *tickling* is one of considerable interest. I have the details of the case of a little girl who was tickled into *terror* and *convulsions,* from which she never recovered. Her mental and nervous powers appeared to have received a shock, the effects of which were felt during life. There is the history, or the story, of a foreigner, who in this manner induced fatal asphyxia.

519. The remedies and agents which induce their effects on this system, have, like disease, their special action on the spinal organs or functions of this system. This fact is exemplified in the effects of *strychnine* and *cantharides,* as may be seen in the two following cases:

520. *Strychnine.*—A lady, being at Lausanne, in Sep-

tember 1836, consulted a foreign physician there, who prescribed the strychnine; I do not know the dose; I only know that it was afterwards *diminished* to one-tenth of a grain thrice a-day. Two pills were taken at bed-time, and three the next morning; soon after which, the patient was taken with spasm of the muscles about the larynx, and those of one arm. She felt as if strangled. With much effort, she mixed some *eau de Cologne* with water, "snapped at it," and so swallowed it. She was shortly relieved. The dose of strychnine was repeated between breakfast and noon. The same symptoms were renewed; she *felt* and *looked* as if strangled. The muscles on each side of the larynx became tense, like cords: she was again relieved by *eau de Cologne*, which she took hastily, as before. After this, the dose of strychnine was reduced, as I have stated, and was taken without any bad effect.

521. For the following interesting case I am indebted to Mr. Robarts, of Everett Street, Russell Square.

522. *Cantharides.*—A young lady, aged twenty-seven, had a fatty tumor within the tenth and eleventh dorsal vertebræ; it gradually, but completely, severed the spinal marrow, and induced perfect paraplegia. The bladder lost its power of retention. The singular fact in this case was the following:—On giving a dose of tincture of cantharides, the power of retaining the urine was always restored *for the time.* This power would cease, and again be restored, on suspending or repeating the medicine.

523. It is obvious that the cantharides acted through the segment of the excito-motory system, left below the division of the spinal marrow.

524. What strychnine effects with regard to the larynx and pharynx, cantharides effect in regard to the cervix vesicæ: the reflex function of these parts is augmented, and stimuli, which have no such effect naturally, induce morbid and even spasmodic actions. I need not illustrate by cases the special and local action of aloes, or of the ergot of rye.

525. On the other hand, certain localities are more susceptible than others to the effects of the excito-motory stimulus: the sole of the foot is especially one of these. Dr. Little has published, in his Thesis, an interesting case of distortion

of the foot, which only, but uniformly, occurred when it was placed upon the ground.

526. "Juvenis quidam si planta pedis humum attingebat, spasmo tonico gastrocnemiorum afficiebatur, quo calx sursum trahebatur. Sin æger sella sedebat vel supinus jacebat, pedem naturali modo undique movere et gastrocnemiis prorsus imperare potuit. Quoties vero digitis humum tangebat, ut infra fusius retulero, gastrocnemii spasmodice contrahebantur."

527. Dr. Dieffenbach met with a similar case.

528. The principal applications of the therapeutics of the excito-motory system, is in the treatment of asphyxia, of certain kinds of convulsion, of sickness, of asthma, of impaired power of the sphincter vesicæ.

529. In some cases of asphyxia, and especially in the case of the asphyxia of the newly-born infant, the excitement of the trifacial, or spinal, nerves, by exposure to the cold atmosphere, or dashing cold water on the face or trunk, is, as I have said, a most important remedy. We may also irritate the nostrils, the fauces, or the glottis, and attempt to excite the actions of sneezing, vomiting, and coughing. Galvanism may be applied with similar views.

530. The occurrence of convulsion is frequently prevented, and the larynx, closed in certain convulsions, is opened, by dashing cold water over the face.

531. Asthma is sometimes removed by the inhalation of certain vapours, as the smoke of the stramonium, the vapour of creosote, &c.

532. Enuresis has been remedied by the action of cantharides.

533. The feeble action of the uterus has been excited by the secale cornutum.

534. These subjects will be noticed more particularly in the course of this volume. I have adduced enough to establish the principle of the specific action and direction of those agents which specially affect this system.

CHAPTER III.

THE GANGLIONIC SYSTEM, OR SYSTEM OF SECRETION, NUTRITION, ETC.

535. I COME now to treat briefly of the Ganglionic System, or system of nutrition, secretion, &c. Little is known of this system distinctly or experimentally. M. Brachet, in his work entitled "Recherches sur le Système Nerveux Ganglionaire," has not distinguished between the true spinal and ganglionic systems. The subject is still open to new investigations.

536. The cerebral system is concerned with *psychical* or mental acts merely; the true spinal, with *physical* acts on the *masses* of bodies to be appropriated to or expelled from the animal œconomy; whilst the ganglionic system relates to the *chemical* changes in the disposition of the *atoms* of the animal body, its solids, fluids, &c.

537. These remarks, which I shall have to repeat, sufficiently distinguish these sub-divisions of the nervous system.

538. As the true spinal system, then, governs the ingestion and egestion of *masses*, in regard to the animal œconomy, so the ganglionic regulates the interstitial absorption, deposition, re-absorption, and the secretion of the *atoms* or *particles* of which the animal frame is composed, and of the ingesta and egesta.

539. I need scarcely observe, that there are *external* as well as *internal* parts which require the interstitial deposit and re-absorption of the atoms of animal matter. It was to be *expected*, therefore, that there would be an external as well as internal ganglionic and nutrient system. This we find accordingly, although it has never been so viewed or stated before.

540. For the external organs, the ganglia on the posterior roots of the spinal nerves are probably destined; for the head, the series of ganglia found upon and in connection with the trifacial nerve; for the lungs, stomach, &c. the

pneumogastric; for the internal viscera, the ganglionic system, commonly so called.

Section I.—*The Anatomy of the Ganglionic System.*

541. This system is sketched, *Plate* II, *figure* 2. It comprises the ganglionic parts of the trifacial and spinal nerves, the pneumogastric, and the ganglionic commonly so called.

542. The ganglia upon the nerves were first observed to be attached to the portio major of the trifacial and the posterior spinal nerves, not, as Sir Charles Bell states*, by Monro, but by Prochaska. This latter author observes, in the preface to a republication of his work in 1800:—

543. Hic tractatus, qui anno 1779 prodivit, plures novas observationes circa structuram systematis nervosi a me factas continet. Harum nonnullæ, quibus in textu non fuit locus, in explicatione figurarum uberius exponuntur, ad quas spectat nova arbor vitæ corporum olivarium, vid. *Tab.* I, *fig.* 3, 4, 5; fasciculus funiculorum nerveorum quinti paris cerebri, qui insalutato ganglio semilunari sub eodem tertium ramum ejus nervi maxillarem inferiorem dictum petit, vid. *Tab.* II, *fig.* 4, 5; sic quoque radices anteriores omnium nervorum spinalium, quæ insalutata ganglia radicum posteriorum transeunt, vid. *Tab.* III, *fig.* 1, 2. Super eandem materiem plura præclara scripta isto tractatu serius in lucem prodivere, inter quæ præcipue *Monroi Observations on the Structure and Functions of the Nervous System* (1783); *Soemmeringi Ueber das Organ der Seele, Königsberg,* 1796; et *Reilii Exercitationes Anatomicæ de Structura Nervorum,* 1797, adnotari merentur."

544. I am not aware that any preceding inquirer has suggested the real office of the ganglia on the trifacial and posterior spinal nerves.

545. Prochaska asks, p. 353, " Quis rationem dabit" —" Quare radices anteriores nervorum spinalium ganglia spinalia insalutata transeant, et quare nam solæ posteriores radices ganglia spinalia tranare cogantur." . . . " Quare omnium cerebri nervorum solum quintum par post ortum suum more nervorum spinalium ganglion semilunare dictum facere debet, sub quo peculiaris funiculorum fasciculus ad

* The Nervous System, 1830, Pref. p. vii, &c.

tertium quinti paris ramum maxillarem inferiorem dictum, properat insalutato ganglio semilunari ad similitudinem radicum anteriorem nervorum spinalium?"

546. Sœmmering has asked similar questions. Sir Charles Bell has quoted Prochaska, and Sœmmering, and Scarpa, in a tone of exultation; but I confess that to me it appears that that justly celebrated physiologist has not approached any nearer to the solution of these questions than his predecessors. Sir Charles Bell has, I believe, distinctly proved the difference of function between the anterior and posterior spinal nerves, and between the respiratory and other nerves—brilliant discoveries—which will, as long as anatomical and physiological science last, perpetuate the memory of his genius; but there is no connection between the function of sensation and the existence of a ganglion*: the unequivocal sentient nerves, as the olfactory, the optic, the auditory, are without any thing very distinct of this kind, whilst the ganglionic nerves are without sensibility, or nearly so.

547. The questions, then, still remain, why are the portio major of the trifacial, especially, and of the posterior spinal nerves, provided with ganglia? The reply to these questions, and the argument, may be stated thus:

548. 1. There is an internal nerve for formation, nutrition, secretion, &c. 2. This nerve is ganglionic. 3. There are external organs and structures requiring nutrition, &c. 4. There are also external ganglionic nerves. The inference is plain, that these constitute the external ganglionic subsystem. The fifth especially abounds with ganglia.

549. It is true that the semilunar and external spinal ganglia differ in appearance from the ganglia of the sympathetic, as Sir Charles Bell has well displayed. What is the nature of this difference? To this question I find no reply in authors. It is plain, however, that the difference consists in their being, alone, *plexic*. The internal ganglionic nerve is purely nutrient: its ganglia are simple. The external involve sentient, and I believe excitory, nerves, with the nutrient; they combine, therefore, the appearances of the plexus and of the ganglion.

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* See Swan's Comp. Anat. of the Nerves, p. 26

550. But are there any other anatomical facts, any physiological and pathological facts, which lead us to think that the trifacial and spinal nerves, besides their other functions, possess a nutrient and secretory power? Indubitably there are.

551. The distribution of this nerve to the lacrymal, parotid, and submaxillary glands, can only be for secretion. I may refer, upon this point, to the beautiful Dissertation of Signor Bellingeri.

552. I must also notice particularly a branch of the trifacial nerve discovered by M. Arnold, and termed by him the *recurrent* of the fifth. It returns from the ophthalmic branch of this nerve, to be distributed between the laminæ of the tentorium. What can its function be, in this situation? It cannot be *touched*. It cannot, then, be for *sensibility*. It cannot be for *excited* motion. It can only be for formation, for nutrition. Such, then, is the *probable* function of this nerve. See *Plate* VI, *fig.* 3.

553. I will conclude these remarks by referring to the sketch, *Plate* VII, *fig.* 4, which shews the distinct *union* of the *external* and *internal* ganglionic systems.

Section II.—*The Principle of Action in the Ganglionic System.*

554. The *vis nervosa* is, I believe, demonstrably the source of the excited reflex actions and functions. The same power is probably, in its *direct* or *immediate* influence, the source of the *movements* of the *internal* organs—the *heart*, the *stomach*, the *intestines*, &c.; the organs of secretion, of nutrition, &c.

555. The same organs and functions are also under the influence of *emotion*.

Section III.—*The Physiology of the Ganglionic System.*

556. I should now proceed to treat of the physiology of the ganglionic sub-division of the nervous system: but every thing here is *atomic*, and only to be observed in its *effects*.

It is therefore chiefly by inducing and observing the pathological effects of a subtraction of the influence of this system, that we are led to discoveries in regard to its physiology; and it is, therefore, under the head of *pathology* that this subject must be treated of. I therefore proceed at once to

Section IV.—*The Pathology of the Ganglionic System.*

557. Of the different parts of this system, most is known of the influence of the trifacial and pneumogastric nerves. I shall notice these in succession.

558. I shall first adduce the interesting experiments* of M. Magendie, in which he divided the trifacial within the cranium. Besides the loss of *sensibility*, and of the *excito-motor property*, the following phenomena were observed:

559. " A. Après vingt-quatre heures de la section, la cornée commence à devenir opaque; après soixante-douze heures, elle l'est beaucoup plus, l'opacité augmente, et cinq ou six jours après la section elle est de la blancheur de l'albâtre.

560. " B. Dès le deuxième jour, la conjunctive rougit, paraît s'enflammer, et sécrète une matière puriforme, lactescente, fort abondante; les paupières sont largement ouvertes et immobiles, on bien elles sont collées par les matières puriformes qui sont desséchées entre leurs bords, et quand on vient à les écarter il s'écoule une assez grande quantité de la matière dont je viens de parler.

561. " C. Vers le deuxième jour qui suit la section on voit aussi l'iris devenir rouge, ses vaisseaux se développent, enfin l'organe s'enflamme. Il se forme à sa surface antérieure de fausses membranes, qui ont comme l'iris la forme d'un disque percé à son centre. Ces fausses membranes finissent par remplir la chambre antérieure de l'œil, et contribuent à faire paraître la cornée opaque. N'est ce pas un phénomène bien extraordinaire qu'une inflammation vive avec suppuration et insensibilité complète de la partie inflammée, et qui est causée par la section d'un nerf?

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* Journal de Physiologie, tome iv, p. 178.

562. " D. Vers le huitième jour qui suit la section de la cinquième paire, la cornée s'altère visiblement; elle se détache de la sclérotique par sa circonférence, et son centre s'ulcère: au bout de deux ou trois jours, les humeurs de l'œil troubles et en parties opaques, s'écoulent, et l'œil se réduit à un petit tubercule qui n'occupe qu'une très petite partie de l'orbite."

563. The cases of destruction or compression of the trifacial within the cranium, from disease of the human subject, are of the same character. Such a case is amply detailed by M. Serres. Such cases have occurred to Dr. Alison and Mr. Stanley, and these I shall quote at length:

564. " A remarkable circumstance connected with the affections of the fifth nerve, is the tendency to inflammation and sloughing in parts which have lost their sensibility, particularly in the eye. A very instructive case of this kind occurred to my friend Dr. Alison. The patient had loss of common sensation on the left side of the face, the left nostril, and left side of the tongue, with insensibility of the ball of the eye, and occasional bloody discharge from the left nostril, and was liable to attacks of pain, occasionally accompanied with fever, during which the pain was chiefly referred to the insensible parts. There were frequently attacks of inflammation of the left eye, with dimness of the cornea, which were relieved, from time to time, by the usual antiphlogistic means; but at the end of two months, a line formed round the base of the cornea, which at length sloughed out, and the contents of the eye were entirely discharged. The muscles of the left side of the jaw were paralytic, and felt quite flaccid when the patient chewed or clenched the jaws; but the motion of the muscles of the cheek was unimpaired. After the destruction of the eye, the paralytic symptoms remained stationary for a year or more; there was then a violent return of headach, with fever, and death in a state of coma, after an illness of a fortnight. On inspection, there was found considerable ramollissement of some of the central parts of the brain. The fifth nerve of the left side, on being traced backwards from the ganglion, was found, close to the ganglion, to be of a very dense texture; but beyond this it was much wasted, and, at its junction with the tuber annulare, nothing

but membrane seemed to remain. In another case of Dr. Alison's, there was loss of sensation of the left side of the face, followed by inflammation and sloughing of the eye-ball; after which, the sensibility of the parts returned. The patient was, before the appearance of these symptoms, and has since continued, liable to severe headach and epileptic fits. The loss of sensibility continued about six months."

565. "A remarkable combination of symptoms occurred in a case related by Mr. Stanley. There was hemiplegia of the left side, without loss of sensation in the arm and leg; but, in the left side of the face, both sensation and motion were entirely lost. In the left side of the tongue, sensation was lost, but motion remained. The mucous membrane of the left nostril was always of a deep red colour, and there were frequent discharges of blood from it. The conjunctiva of the left eye became deeply injected; this was followed by opacity and ulceration of the cornea, and at last by total disorganisation of the eye. There was total loss of hearing in the left ear. There were frequent attacks of erysipelas, which were entirely confined to the paralytic parts of the face. The patient had been long affected with headach, and, at last, died, two months after the commencement of the paralytic symptoms. A tumor was formed in the left side of the tuber annulare, which compressed the origin of the fifth and seventh nerves against the base of the skull. The tumor was the size of a walnut, and extended into the left crus cerebelli*."

566. I must add another argument upon this point. If the sensation of the face be lost by paralysis, arising from disease of the *brain*, the eye is safe; but if the same event occur from compression or destruction of the *trifacial within* the cranium, by disease, or in an experiment, the eye ceases to be nourished, and becomes destroyed! In the former case, the nerve of sensation merely has suffered; in the latter, the nerve of nutrition, as well as sensation, has been involved in the disease or injury.

567. An interesting fact presented itself to me some time ago. A lady had violently torn the integuments on the inside of the fore-finger, lacerating the nerve of the inner edge. The

* Abercrombie on the Brain, 3rd edit. p. 424, &c.

nail on that finger grew ever afterwards far less rapidly than that of the fore-finger of the other hand. Whilst the latter required cutting thrice, the former required to be cut once only.

568. Not the nerve only, but a full and sufficient supply of blood, is required for nutrition. In my experiments on the effects of loss of blood in dogs, I observed that the cornea became opaque. The same effect was induced in the same animals by M. Magendie, by feeding them upon insufficient food. And I have seen a similar dimness of the cornea in the human subject, in the state of gradual sinking, from impaired and failing digestive powers. Compare § 141.

569. Notwithstanding all that has been done in regard to the influence of the pneumogastric nerves on the secretions in the lungs, stomach, &c. this question is still unsolved—still sub judice; and new experiments are required to determine accurately the action both of the pneumogastric nerves and of the ganglionic system, on secretion, &c. Experiments should be made, not on the lungs and stomach only, but on the secretion of the kidney and liver.

570. I must here adduce the conclusions drawn by Dr. J. Reid, from a series of experiments on the sympathetic in the neck:

571. "From these experiments it would appear, that in rabbits, the superior ganglion of the sympathetic, and a considerable portion of the trunk of that nerve as it lies in the neck, may be generally removed without effecting any change upon the iris; while the compression or section of the trunk of the sympathetic in the neck in dogs and cats is instantly followed by contraction of the pupil, the forcing of the cartilaginous membrane over the inner part of the anterior surface of the eye-ball, the retraction of the eye-ball deeper into the socket, and a slight approximation of the eye-lids. In dogs, this also is followed—sometimes after a very few minutes, but generally after a longer interval—by inflammation of the *conjunctiva*, which is occasionally so severe, that this membrane presents an almost uniform redness, and is covered by puriform mucus, and the cornea becomes dim*."

* Edinb. Med. and Surg. Journal, No. 140.

572. I must next advert to the effect of injury or disease of the spinal marrow, on the secretion of the kidney and of the bladder, as another subject for further investigation.

573. Sir Benjamin Brodie remarks—" The first effect of a severe injury of the spinal chord is not unfrequently to occasion a marked diminution in the quantity of urine secreted." And after other important remarks to be noticed hereafter, he adds—" In some cases, the urine which is first secreted after the occurrence of the accident, although of an acid quality and free from mucus, has a peculiarly offensive and disgusting odour. In other cases, the urine is highly acid, having an opaque, yellow appearance; and it deposits a yellow, amorphous sediment."

574. " But the most common change produced in the urine, by an injury of the spinal chord, is the following: It is voided of an ammoniacal odour, and turbid; when allowed to cool and remain at rest, it deposits a large quantity of adhesive mucus; and when tested with reddened litmus or turmeric paper, it is found to be highly alkaline. After some time, a quantity of white matter (phosphate of lime) may be detected in the mucus, and it is tinged with blood. At a still later period, a considerable quantity of coagulum of blood is blended with the mucus and urine. These appearances very commonly shew themselves as early as the second or third day after the occurrence of the accident; sometimes not before the end of a week, or even eight or nine days*."

575. A series of experiments alone could determine whether the destruction of the ganglia on the posterior roots of the spinal nerves, would influence the nutrition of individual parts or limbs. Some of the cases of defective growth, development, and nutrition, in infants, may depend upon disease situated so as to interfere with the texture or function of these ganglia. Observation must elucidate this point.

576. The whole nervous system seems to have a certain influence over the action of the heart. According to the experiments of Legallois and Dr. Wilson Philip, to *crush* the brain or the spinal marrow enfeebles or arrests the circulation. I have discovered that the same effect is produced by crush-

* Medico-Chirurgical Transactions, vol. xx, p. 143.

ing the limbs; and this is doubtless effected through the medium of the ganglionic system.

577. *Exp.* I made a frog perfectly insensible by the application of laudanum or alcohol. Its respiration ceased. It did not move on the application of any irritant. The circulation in the web was carefully observed. When it had long continued in the same enfeebled state without change, the thigh was crushed. The circulation in the minute and capillary vessels ceased at once, and never returned. The stomach was now crushed in the same manner. The heart ceased to beat for many seconds; its beat then returned, but never regained its former force. The effect was precisely such as was observed by Legallois on crushing the spinal marrow. There was not the least indication of pain in either experiment.

578. The experiment was repeated. The result was so perfectly similar, that a note was written at the time, stating that the experiment need not be repeated again.

579. Nevertheless, it was repeated several weeks afterwards, with precisely the same results. The action of the spirit upon the cutaneous surface had arrested the respiration, destroyed all sensation, and induced considerable languor in the circulation in the web. When this state had continued uniform during a considerable time, the other limb was crushed by a hammer. There was not the slightest motion of the animal or expression of pain, so deep was the insensibility. The circulation in the whole web ceased instantly.

580. The spinal marrow being removed in an eel, the circulation became, at length, much enfeebled in the pectoral fin. The part one inch and a half below the heart was crushed; the circulation in the pectoral fin now ceased suddenly and entirely.

581. In an eel, in which the brain had been carefully removed, and the spinal marrow destroyed, the stomach was violently crushed with a hammer. The heart, which previously beat vigorously sixty times in a minute, stopped suddenly, and remained motionless for many seconds. It then contracted; after a long interval it contracted again, and slowly and gradually recovered an action of considerable frequency and vigour. No experiment can more clearly

demonstrate the effect of violence inflicted upon the system generally. The experiment is the more remarkable because the connection and influence of the brain and spinal marrow were entirely removed. The organic structures must have been the medium through which the effect of the violence was conveyed to the heart.

582. Similar events have occurred in surgical practice. A robust and healthy waggoner fell down, and the wheel of his heavy waggon passed over the abdomen. The beat of the heart was so enfeebled that the pulse could scarcely be felt. No reaction took place. The effect was perfectly similar to that of crushing a portion of the brain and spinal marrow. On examination, the ileum was found lacerated in two places.

583. A man had his arm drawn in, and violently crushed, and torn off, by some machinery. The action of the heart failed, and never rallied.

584. Every one will remember the melancholy accident which occurred to the late Mr. Huskisson. The tremendous vehicle passed over the thigh. The action of the heart failed, and the surgeon waited for re-action—for an opportunity for amputation—in vain.

Section IV.—*The Therapeutics of the Ganglionic System.*

585. This is a subject involved in the deepest obscurity. Every secretion involves a due supply; 1, of blood, and 2, of nervous influence. It is, therefore, through *both* of these, that every diminished, augmented, or altered secretion is affected; and that the *hydragogues*, the *cholagogues*, the *emmenagogues*, &c. of the former system of therapeutics acted.

586. That the nervous influence is very considerable is proved by the efforts of mental emotion and appetite. That the influence of the condition of the blood is great also, is demonstrated by the well-known and admitted facts belonging to what was formerly designated the humoral pathology.

587. We have here presented to us another open field, requiring renewed culture, and promising a rich harvest to the new labourer.

588. I may here suggest one mode of inquiry: we may *isolate* the ganglionic system in the frog, as described, § 577, and we may then try the effect of various re-agents, as heat, cold, galvanism, strychnine, the hydrocyanic acid, &c. applied to the general surface, to the stomach, the intestine, &c. The latter applications are readily made by means of a syringe and a fine silver tube, protected at the point by a slight enlargement, in the manner of the blunt-pointed probe.

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589. I may thus conclude my observations on the Nervous System in general:

590. This system is divisible into—

591. I. The Cerebral, or psychical, or that of our relation to the external world *mentally;*

592. II. The True-spinal, or excito-motory, or that of the reflex action of the *vis nervosa*, or of our appropriation of certain objects of the external world *physically* and *in masses;* and

593. III. The Ganglionic, or the system of *interstitial*, or *chemical*, or *atomic* changes, of nutrition, secretion, &c. also under the immediate influence of the *vis nervosa.*

594. IV. Intermediate between the *first* and *second* of these is the influence of *emotion, passion*, &c.

595. V. Intermediate between the *second* and *third* are the internal muscular organs, the heart, the stomach and intestines, &c.; and these are under the *immediate* influence of the *vis nervosa* and the *irritability* of the muscular fibre.

596. VI. Lastly, the *tone* and *irritability* of the general muscular system are *constant* and *direct* effects of the True-spinal and Ganglionic systems, and of the *vis nervosa.*

CHAPTER IV.

THE NERVOUS SYSTEM IN THE FŒTUS AND INFANT.

597. How marvellous is that change of functions which instantaneously occurs on the birth of the fœtus, and what an interesting object of inquiry does it present to us!

598. The fœtus in utero seems restrained to a sort of ganglionic life. Every thing consists in nutrition and growth, or development. The contact of the liquor amnii is sufficient to keep the eye-lids, the lips, and the sphincters closed. But the moment the fœtus passes out of a bland fluid, of blood-heat, into a stimulant atmosphere of lower temperature, new actions are *excited*, new phenomena induced.

599. The impression of the cool atmosphere on the cutaneous *origins* of the trifacial and spinal nerves, induces the first inspiration, just as dashing cold water on the face, or on the general surface, will induce a sobbing inspiration in the adult. For the first inspiration is excited through these incident nerves, and not, as Prof. Müller has imagined, through the impression of arterial blood on the medulla oblongata* (this view inverting cause and effect); any more than continued respiration is induced by venous blood in the lungs (for then we should have rapid respiration in the hibernating animal). But respiration is *first* excited by the new contact of the atmospheric air with the incident trifacial and spinal nerves, and afterwards by that of evolved carbonic acid with the *origins* of the pneumogastric on the air-cells and minutest bronchial tubes.

600. But the contact of the cool atmosphere affects the sentient system, and hence the new-born infant begins to *cry*.

601. The contact of the atmospheric air excites other new functions. It probably induces the first efforts at suction

* See Baly's translation of Müller, vol. i, p. 355.

(a new-born infant sometimes sucks its own lips), and the expulsion of the urine and fæces. We know that, as the sudden contact of cold water with the face and general surface, in adults, induces sobbing, so the more continued contact of cold water with the limbs, &c. induces the disposition to void the bladder and rectum. This is observed in bathing. I have repeatedly remarked, that horses and cattle, in passing a rivulet, are excited to evacuate the bladder and rectum. The elephant at the Zoological Gardens is frequently affected in a similar manner on going into his bath. The young child voids the bladder, on being "held out," as the phrase is, from the similar influence of cold.

602. If the atmosphere itself be warmer, above the temperature of the blood, the moist surface of the new-born infant soon becomes cold by evaporation. The oxygen of the atmosphere may also act as a stimulus.

603. The finger or nipple excites more distinct acts of suction. To introduce an enema-pipe excites the expulsive efforts of the rectum.

604. In these different modes, this *new* life of the fœtus is excited through the true spinal marrow. The phenomena may be *aided* by the cerebral system; but they take place in the anencephalous fœtus, in the new-born animal deprived of the cerebrum; so that they are essentially functions of the *true-spinal marrow*, with its incident and reflex nerves. It is the fact of the new kinds of excitement of this system, which induces the *first* difference between the intra-uterine and extra-uterine life. The *cerebral* system is called into action more gradually and more remotely.

605. May not the *arterialization* of the blood, the effect of the newly excited function of respiration, be the further cause of newly excited *ganglionic* actions, and of the *secretions* of the fæces and urine, which begin immediately afterwards?

606. We thus see how the three divisions of the Nervous System stand related to each other. The fœtus, then, is *chiefly* under the influence of the ganglionic system; the newly born infant is under the influence of the true spinal marrow; afterwards the cerebral system is gradually developed with the age of the individual.

SECTION I.—*The Congenital States of the Nervous System.*

607. The condition of the fœtus in utero is, then, principally one of ganglionic existence. Nay, in many instances of imperfect formation, not only the cerebral, but the true spinal system, is undeveloped. There is, in fact, no degree in which imperfection of the nervous system may not exist in the fœtus in utero.

608. There may be complete absence both of the spinal marrow and of the encephalon, in which case the fœtus is termed *amyelous*, or *amyelencephalous*. There may be the absence of the encephalon,—of the cerebrum and cerebellum only; in this case the fœtus is designated *anencephalous*. Or the cerebrum merely may be in a state of defective development, or of *atrophy*, more or less partial or extensive.

609. The amyelous fœtus cannot survive the moment of birth. The anencephalous fœtus may support an extra-uterine life for several hours, displaying the interesting spectacle of the phenomena of the true spinal or excito-motory system, exclusively, in the human subject; but these phenomena gradually cease, or, in other terms, the anencephalous fœtus is not *viable*, the influence of the brain being required, in addition to that of the spinal marrow, for the continuance of life. In the case of atrophy, the fœtus is viable, and may survive for years, but in a more or less idiotic or paralytic condition; that is, with greater or less defect of the sentient and voluntary functions, according to the degree of atrophy or defect of the encephalon.

610. I need not adduce any examples of the amyelous *fœtus*, which is always anencephalous too, and generally affected with spina bifida. It affords no illustration of events which occur in extra-uterine life,—or disease.

611. Of the anencephalous fœtus we have most interesting accounts by Mr. Lawrence, M. Lallemand, M. Ollivier, &c.

612. The description of the phenomena presented in such a case, witnessed and recorded by Mr. Lawrence, is as follows:—"The child moved briskly at first, but remained quiet afterwards, except when the tumor was pressed, which occasioned general convulsions. It breathed naturally, and

was not observed to be deficient in warmth, until its powers declined. I regret that, from a fear of alarming the mother, no attempt was made to see whether it would take the breast: a little food was given it by the hand. It voided urine twice in the first day, and once a day afterwards: it had three dark-coloured evacuations. The medulla spinalis was continued for about an inch above the foramen magnum, swelling into a small bulb, which formed the soft tumor on the basis of the skull. All the nerves, from the fifth to the ninth, were connected to this." This brief detail is full of interest. The respiration was natural, the medulla oblongata being entire. Swallowing was effected when the food was brought into contact with the pharynx; the sphincters performed their functions; the limbs were moved when the skin was first impressed by the atmospheric air. There was no indication of sensation—the child remained quiet after the first brisk movements, and no event is mentioned which could establish the existence of voluntary motion,—the acts of swallowing, and the expulsion of the urine and fæces, with the functions of the larynx and of the sphincters, belonging distinctly to the excito-motory system.

613. M. Lallemand has briefly described a case of anencephalous fœtus*. " J'ai vu, il y a quatre ans, à l'Hôtel Dieu, un fœtus anencéphale, à terme, ou à peu près, qui vécut trois jours. Pendant tout ce temps il poussa des cris assez forts, exerça des mouvemens de succion toutes les fois qu'il sentit quelque chose entre ses lèvres; mais on fut obligé de le nourrir avec du lait et de l'eau sucrée, parce qu'aucune nourrice ne voulait lui donner le sein. Il exécutait des mouvemens assez étendus des membres thoraciques et abdominaux. Quand on plaçait un corps étranger dans ses mains, il fléchissait les doigts comme pour le saisir; mais en général tous ses mouvemens avaient moins d'énergie que ceux d'un fœtus de même âge.

614. " Le cerveaux et le cervelet manquaient entièrement: il ne restait à la base du crâne que la moëlle allongée et la protubérance annulaire, avec l'origine des nerfs pneumogastrique, trifacial et optique. Le tout était recouvert par les débris des os du crâne, des méninges et de la peau."

* Observations Pathologiques, p. 86.

615. A similar case is detailed by M. Olliviert, who remarks—" J'observai l'enfant anencéphale deux heures après sa naissance. Les yeux étaient constamment fermés; il poussait des cris fréquens qu'on calmait facilement en introduisant le petit doigt dans sa bouche: il exerçait alors des mouvemens de succion répétés; il agitait ses membres avec assez de force, et serrait entre ses doigts les corps qu'on plaçait dans ses mains.

616. " Je le revis au bout de trois heures. Les pieds et les mains étaient devenu violets et froids; la respiration ne s'opérait plus à des intervalles aussi rapprochés; les mouvemens de la moëlle épinière, que j'avais remarqués d'abord, continuaient toujours d'avoir lieu, et suivaient chacune des grandes et longues inspirations qu'il faisait. Les cris étaient moins forts et moins fréquens: on lui donna à diverses reprises de petites cuillerées de vin vieux sucré.

617. " Insensiblement le refroidissement des extrémités gagna le reste des membres et le tronc; la respiration s'opérait à de plus longs intervalles: elle devint convulsive. Cet état persista pendant six ou huit heures; ses cris devinrent plus faibles et plus éloignés, de même que les mouvemens de la respiration, qui étaient accompagnée de convulsions générales, et il mourut dans un véritable état d'asphyxie, après avoir poussé un cri analogue à celui qui résulte du hoquet."

618. M. Ollivier adds, (p. 161)—" Il n'existait pas ici un seul rudiment de l'encéphale et des prolongemens de la moëlle alongée; la moëlle épinière seule était restée intacte, et cependant cet infant exerçait des succions répétées, et serrait avec assez de force entre ses doigts les corps qu'on plaçait dans sa main; ces mouvemens étaient loin d'être automatiques comme ceux qui agitaient les membres inférieurs."

619. These cases, in connection with the preceding one, are full of interest. The peculiar cries, which resemble, in their rationale, the croup-like convulsion from dentition; the closed state of the eye-lids; the action of suction excited by the contact of the finger; the closure of the fingers excited by objects placed in the palm of the hand, and the movements of the inferior extremities, in this acephalous infant,

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* Traité de la Moëlle Epinière, ed. 2, Paris, 1827, p. 155.

are phenomena of the reflex function of the most deeply interesting character.

620. The following facts are extracted from a letter addressed by Mr. Sweatman to Sir Charles Bell, and published in the "Nervous System*" :—In a case of parturition, "after the membranes had given way, and the liquor amnii had escaped, the midwife, on examining, found another membranous bag presenting, which she naturally supposed belonged to a second child, and therefore did not interfere. During the passage of this bag under the os pubis, it suddenly burst, and the whole of the brain escaped from the opening, very much smashed, and hanging together only by its membranes. The child breathed with perfect freedom, and cried strongly, rolling its eyes about in a wild, staring manner. It moved its lower extremities freely, and that not from spasm, but *obviously in obedience to external impressions*. There was no motion whatever of the upper extremities.

621. "In this state it remained for about three hours, when all motion in the extremities ceased, the eyes became fixed, and the breathing gradually slower, till it ceased altogether, just seven hours after the birth of the child. During this time, neither urine nor meconium passed, nor had there been any hæmorrhage from the vessels of the brain.

622. "On examination, the occipital bone and the posterior part of several of the cervical vertebræ were found wanting, and their place had been occupied by fluid, surrounded by a membranous bag; an instance of spina bifida of the neck. The spinal marrow was perfect.

623. "A somewhat similar case occurred to me about three years ago, when I had occasion, from peculiar circumstances, to remove the brain of a child through the anterior fontanelle. In that instance, about ten minutes elapsed before its birth; yet it drew a deep inspiration, and would have cried had it not been prevented; and the motions of the *lower* extremities continued about half an hour, although the whole of the brain had been removed, and a blunt instrument repeatedly thrust down the foramen magnum†."

* Appendix, p. cxxxvi.

† See a similar case by Mr. Hammond, in the Medico-Chirurgical Transactions, vol. xii, p. 308.

624. By the kindness of my friend Mr. Wallace, of Hackney Road, I had the opportunity of witnessing, in its last moments, a fœtus in which the cerebrum was too little developed for life to be sustained. It survived its birth fifty-five hours. At the expiration of this time I saw it. I watched its movements during twenty minutes.

625. There were only occasional inspirations, followed by expirations, attended by a peculiar noise in the larynx.

626. It lay still. I applied my thumb and fingers so as gently to press the integuments of the thorax. There was an immediate excited movement of the anterior extremities upon the thorax.

627. All at once spontaneous movements of the four extremities took place, such as the nurse had not observed before. It was the spasm of death. The infant ceased to breathe.

628. The cerebrum was found in its lowest degree of development; but still it did exist, together with the cerebellum.

629. I need not say how much I regret not having had the opportunity early of watching this interesting case.

630. Such are a few of the facts which prove the presence of a system of excito-motory functions attached to the medulla spinalis, and existing independently of the brain, in the human subject. The excited acts of suction on stimulating the lips; of deglutition on stimulating the pharynx; of the closure of the hand on stimulating the palm; of the lower extremities "*obviously in obedience to external impressions;*" are all phenomena of the deepest interest, as illustrations of this system.

631. M. Lallemand, who has attended most to this subject, still considers these motions to arise from *sensation;* and yet, singularly enough, considers *volition* as suspended.

632. It is impossible to conceive a greater confusion of all ideas on this physiological question, than is presented in the following paragraph, which I quote from this author, and several parts of which I mark with particular emphasis:— "The instinctive automatic movements produced directly by

sensations, without the medium of reflection or of volition, are observed at all periods of life; during sleep, they preside over respiration, replace the deranged bed-clothes, push aside those which are too warm; shrink from a puncture, tickling, or external pressure, or change the position (!); *the whole* without the least consciousness on the part of the brain (!)." I could not adduce a more lively proof of the necessity of reconsideration of this subject.

633. What are the movements produced immediately by sensation? There can be no such thing. How can sensation act in inducing motion, except through the medium of volition or emotion? It is impossible. And who can confound the *excited* motions of respiration, with the *voluntary* act of replacing a coverlet?

634. There is another remark of M. Lallemand, of which I am compelled to say that it is equally unfounded. "This immediate influence of the spinal marrow on the nerves which go to it and from it, becomes gradually weaker as that of the brain diminishes; but it never disappears altogether." The truth is, that the intellectual functions are daily developed during the first years of life, and *obscure* those of the excito-motory; but the latter are not *enfeebled* during this change, which is one of *superaddition*, not of *substitution*.

635. The account of the phenomena presented by the anencephalous infant, during the few hours of its extra-uterine life, drawn up by one well imbued with the distinction of the functions of the cerebral, or sentient and voluntary, and the true spinal, excito-motory systems, would possess the deepest interest to the physiologist and pathologist.

636. In the cases of atrophy of the cerebrum, sensation, intellect, and voluntary motion, are *superadded* according to the degree of development of the brain. But, in general, there are proportionate *idiotcy* and *paralysis*; and, as the cerebrum is frequently more atrophied on one side than the other, there is usually some *hemiplegic* lameness of the opposite side of the body. There are frequently epileptic attacks, or contractions of the limbs.

637. M. Lallemand observes, that when the superior and inferior extremities are unequally affected, the former are

always more paralysed or contracted than the latter; and that, whenever the paralysis is not complete, the sensibility is less affected than the movements.

638. Upon this last point, I find it necessary, however, to recur to the want of distinction, on M. Lallemand's part, between the movements which result from sensation and volition, and those which belong to the excito-motory system. I shall, at the same time, again point out the absolute necessity for attention to this distinction. M. Lallemand observes: "Au reste, la question est décidée par les exemples que je vous citai, il n'y a qu'un instant, de fœtus privés de cerveau et de cervelet, qui éprouvent cependant des sensations distinctes, et réagissent sur ces sensations d'une manière assez régulière pour serrer un corps placé dans la main, pour embrasser avec les lèvres le mamelon du sein, exercer la succion et la déglutition*."

639. In every case of a viable infant, I suppose the excito-motory functions will be complete.

640. The external ganglionic sub-division of the nervous system must be carefully examined in every instance of *partial development*, as of an organ, a limb, &c.

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641. Besides those *congenital* diseases which occur in utero, and which consist principally of defective development, or atrophy, or destruction of the encephalon or spinal marrow; hydrocephalus and hydrorachitis, or spina bifida; there are several others, and especially two which supervene *inter partum;* these are *apoplexy* and *asphyxia.*

I. *Of Congenital Apoplexy.*

642. Of the whole number of *still-born* children at the *Maternité* of Paris, M. Cruveilhier says that one-third are affected with *apoplexy.* The *cause* of this affection is most probably the violence inflicted during severe labour. The *form* is *meningeal;* that is, diffused coagula of blood are found between the membranes, especially at the posterior part of the encephalon, and in the ventricles, without rupture of the *substance* of the brain. The symptoms are not to be

* Recherches sur l'Encéphale, tome iii, p. 322.

distinguished from those of feebleness and asphyxia. Some infants have lived with these symptoms for one, two, three, or four days; and some may even have recovered altogether. The *prevention* obviously consists in cautiously accelerated delivery. The *treatment* cannot, until the diagnosis is made evident, be distinguished from that of asphyxia.

II. *Of Congenital Asphyxia.*

643. To *Congenital Asphyxia* I must draw my readers' attention in the most particular manner. It is a case of the utmost emergency. Its prevention and treatment are constantly points of the utmost anxiety to us.

644. The infant is said to be *still-born.* We wait for the establishment of respiration, and this event does not take place. There is a general alarm. We now see the value and importance, in a *practical* point of view, of the principles of the physiology and pathology of the nervous system which I have been detailing. I have stated that respiration is an *excited* function; that it belongs to the excito-motory sub-division.

645. In one word, then, all our efforts must be instantly made to *excite* respiration. Now what are the channels through which this act may be excited? What are the excitors of respiration? The *trifacial,* the *pneumogastric,* and the *spinal* nerves.

646. The *trifacial* nerves must be excited by *forcibly* blowing or dashing cold water on the face, by stimulating the nostrils by ammonia, snuff, pepper, or the point of a needle.

647. The *spinal* nerves must be excited by *forcibly* dashing cold water on the thorax, the thighs; by tickling or stimulating the sides, the soles of the feet, the verge of the anus.

648. What the pneumogastric is, as the excitory nerve of respiration, under ordinary circumstances, the trifacial and the spinal nerves are, in cases of asphyxia, or suspended respiration. The means recommended for exciting respiration through these excitors, frequently induce a sudden act of inspiration, which proves the first of a series, so essential to animal life.

649. The important point to be mentioned, is, that it is not the mere application of cold, but the *sudden* application

of *cold* to a *warm* surface, which is the effectual means of exciting respiration. It is the *sudden alternation.* To apply cold to a cold surface would only be to sink the general powers of life. The infant should be kept warm; the warm bath may be required; and then cold water must be applied, in *moderate quantity*, but with *force.*

650. But if these attempts to *excite* respiration through the trifacial and spinal nerves fail, we must *imitate* this function, by artificially distending the lungs, in the hope that, eventually, it may be excited through its wonted channel, the *pneumogastric.*

651. To effect this, the practitioner's lips are to be applied to those of the infant, interposing a fold of linen, and he is to propel the air from his own chest, slowly and gradually, into that of the infant, closing its nostrils, and gently pressing the trachea on the œsophagus. The chest is then to be pressed, to induce a full expiration, and allowed to expand, so as, if possible, to effect a degree of inspiration.

652. But it is important, in doing this, that the practitioner himself should previously make *several deep* and rapid respirations, and, finally, a full inspiration. In this manner, the air expelled from his lungs into those of the little patient, will contain more oxygen and less carbonic acid, and consequently be more capable of exciting the dying embers of life.

653. I base this suggestion on an interesting communication by Dr. Faraday, in the London and Edinburgh Philosophical Magazine, vol. iii, p. 241, for October 1833, to which I have already referred. It is ascertained that respiration may be suspended longer, as in diving, or in experiments, after such repeated forced respirations, than in ordinary circumstances, from the greater purity of the air in the lungs.

654. If all these plans should be tried in vain, I would strongly advise galvanic or electric shocks, to be passed from the side of the neck to the pit of the stomach, or in the course of any of the *motor respiratory* nerves, and their appropriate muscles. No time should be lost in sending for a proper apparatus; but, should the lapse of an hour, or even more, take place before it *can* be obtained, still it should be sent for and tried.

655. When respiration is established, the *face* must *still* be freely exposed to the air, whilst the temperature of the limbs and body is carefully sustained.

656. In the *midst* of these efforts, it should, in the next place, be the office of two other individuals to maintain or restore the *temperature* of the little infant, by gently but constantly pressing and rubbing its limbs between their warm hands, passing them upwards, in the direction of the venous circulation.

957. An enema of gruel, at 98° or 100°, or *higher*, with a little brandy, should be administered.

658. As soon as possible, a little warm liquid, as barley-water, at blood-heat, should be given by means of the proper bottle, furnished with leather or soft parchment. A teaspoon must not be used for fear of choking. If the infant draws the liquid through its own lips, by its own efforts, there is no danger.

659. Lastly, these various means should be continued or repeated in the most persevering manner.

III. *Of Secondary Asphyxia.*

660. But there is another subject, of the utmost importance, to which I beg to draw the attention of the profession in the most earnest manner. When an infant has been restored from a state of asphyxia, it frequently relapses into a *secondary asphyxia*, and is lost.

661. This is a general fact in regard to asphyxia. I put a bird and a mouse into the same bell-glass, inverted over water. First the bird, and eventually the mouse, began to gasp. I put them into their respective cages. The bird was dead the next day, and the mouse on the succeeding day.

662. Sir Humphrey Davy experienced a secondary attack after breathing hydro-carbonate. A corporal of the Guards, after being apparently restored from asphyxia from submersion, was affected with convulsions and expired.

663. In a case of asphyxia from laryngitis, after the patient had ceased to breathe, the trachea was opened, artificial respiration was performed, and re-animation took place; but the patient expired shortly afterwards.

664. These facts should keep us upon our guard against

secondary asphyxia: we should watch our patient, and be prepared with all our remedies; we should dash cold water on the face occasionally, and expose the face of the patient to the cool, free, open air; and we should enjoin, in an adult, frequent, full, respirations.

665. How interesting would be a series of well-conducted *experiments* upon young animals, with the view of ascertaining, by comparative trials, the degree of efficacy of the various remedies for *asphyxia*. I have sometimes thought that, if one wire of the galvanic apparatus were properly inserted into the nostril, and the other within the sphincter ani, the shock might have great efficacy.

666. There is another view of this subject not less deeply interesting. This secondary asphyxia is the cause of *sudden* death in some other diseases, as the *crowing inspiration*, to be treated of hereafter. In this disease, the infant sometimes dies in an instant—in the twinkling of an eye—much more suddenly, in fact, than from *mere asphyxia*. I believe the blood is poisoned from the imperfect respiration, and that the *coronary circulation* becomes insufficient to sustain the action of the heart, and that this organ therefore fails. It is in this manner that the most sudden of sudden deaths occurs, both in some cases of what I have designated secondary asphyxia, and in disease of the heart itself, and especially in ossification of the coronary arteries,—the impeded circulation through them which occurs in the fatty heart, and other diseases of this organ and of its valves.

667. The *fact*, in regard to the crowing inspiration, should suggest what is found so useful in other respects in this disease; viz. thorough *change of air*, and free exposure to its genial influences. The same indication is especially to be fulfilled in *all* cases of asphyxia, for a considerable time after all apparent danger has ceased.

IV. *Of Idiotcy.*

668. A fearful question comes to be agitated, in some cases at a short period after birth. Is the infant idiotic? Is the cerebrum properly developed?

669. Comparative admeasurements; the *form* of the head; the *expression* of the countenance; the power of *articulation*,

of *walking ;* the *equal use* of the limbs of both sides of the body ; the flow of the *saliva* from the mouth ; these are the points to which our attention must be directed. In *all* these, the idiot is deficient !

670. Afterwards, passion, and the appetites and passions, are frequently developed in the inverse ratio of the intellect. Violence of temper ; excess of the appetite for food ; often excess of the sexual appetite : these are observed in the idiot, who is frequently, at the same time, totally incapable of the sense of propriety, of cleanliness, or of shame.

671. I must not now pursue this subject any further. But I hope one day to detail some interesting facts in regard to this forlorn condition of some individuals of the human race.

V. *Of Spina bifida.*

672. I cannot conclude the subject of congenital diseases of the nervous system better than by giving the following interesting case, already noticed, for which I am indebted to Mr. Herbert N. Evans, of Hampstead :

673. " On the 2nd of November, 1832, I attended, in labour, the wife of a poor man, who was a plumber, and who for some time had been the subject of epileptic attacks. The mother was diminutive and weakly. Whilst the nurse was washing the child, I observed that there was a tumor on the loins, about the size and form of half a French walnut : on examining it, this was found evidently to arise from hydrorachitis. In a short time the tumor lost its shrivelled state, and became distended into a semi-round bag. The child being pretty strong, I resolved to treat the disease by pressure ; when, on compressing it slightly, previously to applying a bandage, I was surprised to find that such pressure was immediately followed by the affection described by Dr. J. Clarke. Whenever the pressure was applied, a similar effect resulted, and the nurse was obliged to be very careful, in laying the child down, not to allow the swelling to bear any part of the weight of the body ; if she did, the severity of the spasm was such as to threaten suffocation.

674. " The tumor became daily more prominent, and its sides thinner, until, after about two months, it appeared as if it would give way. It seemed better now to evacuate the

fluid gradually, rather than allow it to burst: accordingly a small opening was made with a needle, and the fluid, which was limpid, oozed out constantly, without any apparent effect. The child lived until the end of February, when it sank, without any definite complaint.

675. "The name, *chronic croup*, given by some authors, is surely most unfortunate; it is often by no means chronic, and has no relation whatever to croup. It is evidently a convulsion of the respiratory muscles, and in many respects seems to have an analogy with hooping-cough; for instance, the similarity of the hoop, and the tendency of both to pass into general convulsions, death, &c. The above case seems to throw some light upon its nature, inasmuch as it proves that pressure upon the nervous centres (perhaps the medulla oblongata) may, under certain circumstances, produce it."—December 15, 1834.

676. The modes of treatment are palliative or radical: the former is the cautious application of a *truss*; the latter, the equally cautious puncture by a *needle**.

677. There are cases in which there is little hope from any mode of treatment. They are those in which there is evidence of the existence of hydrocephalus, or disease within the head.

678. The great interest of Mr. Evans's case is the proof it affords of the possibility of the *centric* origin of the crowing inspiration. We shall see hereafter that this disease most frequently originates in the incident nerves. It *may*, however, possibly arise from *irritation* or *compression* of the motor nerves of the larynx.

679. The general question of *convulsions* is one of the greatest interest. That the whole *class* of convulsive diseases consists of affections of the true spinal system, there is no longer any doubt. But these diseases do not all *originate* in this system. Some of them originate in the cerebrum; they then arise

680. 1. From *irritation* in diseases of the *meninges*, especially at the *base* of the brain;

681. 2. From *counter-pressure* in diseases, or

* See Sir Astley Cooper's paper, in the Med. Chir. Trans. vol. ii, p. 322.

682. 3. From *contre-coup* in injuries of the encephalon ;

683. 4. From *exhaustion.*

684. In this manner we solve the difficult question of convulsions arising from affections of parts not endowed with the excito-motory property.

685. It is in this manner that we explain the occurrence of convulsions in encephalitis and hydrocephalus, in meningeal or other affections of the base of the brain, or of the spinal marrow, and the effects of extreme exhaustion. In a word, convulsions belong to a *later period*, and the *close* of *all* the diseases of the nervous system ; as, on the other hand, repeated convulsions eventually affect the encephalon.

686. To this important subject I must revert shortly. I will merely mention, in this place, that there is a *living pathology*, certainly not less important than *pathological anatomy*, but hitherto little known, in medical inquiry. It is this living pathology which explains not only why a disease of an organ unendowed with the excito-motory property can induce the phenomena of this property, but why diseases apparently similar induce dissimilar symptoms, and vice versâ; facts constantly noticed and commented upon by M. Andral in the course of his admirable work. An important department of this living pathology is that of the diseases consisting in formidable symptoms, yet leaving *no* trace of pathological anatomy behind them. It is altogether a subject fraught with deep interest, and, if I judge right, with much of discovery, and one to which I would call the attention of the younger members of our profession. It will, I venture to predict, abundantly repay any labour they may bestow upon it.

CHAPTER V.

THE DISEASES OF THE NERVOUS SYSTEM IN INFANTS AND CHILDREN.

687. The subjects of this chapter are again of the most intense interest. They comprise that of the *bane* of infancy and childhood, *hydrocephalus*, and the different forms of *convulsions*, with the prevention, diagnosis, and treatment.

688. The subject is beset with difficulties. These diseases are so insidious, and their diagnosis, from the want of such *physical* signs as assist us so exceedingly in diseases of the thorax and abdomen, is so difficult, the diseases themselves are so formidable, that I know of no subject so replete with anxiety, both to the parent and to the physician.

689. I believe the distinctions which have been recently established in the nervous system will greatly assist us in the diagnosis of these diseases, both in their origin and progress. Indeed, I know of nothing more interesting than to trace the course of these diseases, in their influence, first, on one of the sub-divisions of the nervous system, and then on the other or others.

690. That some of these diseases are of *cerebral* origin, afterwards involving the true spinal and ganglionic systems in their course,—that others are of *true spinal* origin, subsequently affecting the cerebrum and ganglia,—are points quite established. Let us trace these phenomena, and examine how far they guide us in our practice.

691. I must premise that the *cerebral* diseases of infants may be divided into—

1. *Encephalitis.*
2. *Tuberculous Hydrocephalus.*
3. *Hydrocephaloid Diseases.*
    - *a. From Intestinal Disorder.*
    - *b. From Exhaustion.*

692. I will now therefore proceed to treat of several of these diseases, and first

I. *Of Encephalitis and Tuberculous Hydrocephalus.*

693. I shall have occasion again to draw my readers' attention to my sub-division of the nervous system into the sentient and voluntary, the excito-motory, and the ganglionic; for the diseases of which I am about to treat, *begin* in the first, and *proceed* to involve the second, and the last *in their course.*

694. The intrinsic and *practical* importance of these divisions will now be manifest.

695. Encephalitis is only to be distinguished from the tuberculous hydrocephalus—1, by our being able to trace it to some external cause, as a *fall* or *blow,* too frequently concealed by the nurse at the time of its occurrence; 2, by ascertaining the *absence* of hereditary *predisposition;* 3, by its acuter symptoms and course; 4, by the absence of the signs tubercles.

696. Important as the distinction is, therefore, in reference both to the prognosis and treatment, I am compelled to combine the description of these two diseases, pressing upon my readers the absolute necessity of a strict inquiry into the points which I have just mentioned.

697. The *earliest* symptoms of encephalitis, and of tuberculous hydrocephalus, are, then, those which relate to the *cerebral* functions, which are *exalted.* These functions are so slightly developed in infants, that their state of exaltation too frequently passes unnoticed. Yet the phenomena are obvious enough, if there be but a careful observation on the part of the parent, or nurse, on whom the duty of noticing the *dawn* of these diseases must devolve.

698. The *first* symptom is an unhappy countenance and manner, a general expression of pain, of suffering, or at least of uneasiness; the brows are contracted on exposure to light, on being moved or disturbed; the temper is fretful under the same circumstances; the head is, perhaps, moved to and fro continually. The infant is only quiet when left in a state of undisturbed repose. Sometimes there is a perpetual moaning or whining, sometimes a piercing cry.

699. In the *next* place I must mention the state of *the sleep.*

This is broken; and although the little patient is only quiet when let alone during the day, yet its nights are disturbed by restlessness, or starting and crying. There is, in the midst of all this, a peculiar stupor, a sort of coma-vigil.

700. There is intolerance of light and of sound. The eye-lids are forcibly closed, the pupils contracted, on approaching the window or a bright light; any sudden noise induces starting, alarm, crying, &c. The skin is also frequently very sensitive to the contact of the fingers of the medical practitioner, as we ascertain on feeling the pulse, &c.

701. It is in vain to speak of *delirium;* for how is this to be manifested in an infant? However, restlessness takes its place, and constitutes an important symptom; and frequently a deceitful sardonic smile plays upon the countenance, or an expression of fear or fright is written there.

702. Unfortunately, these symptoms, although observable enough, usually meet with some hypothesis in the minds of the parent and nurse, and are referred to the stomach and bowels, &c. &c. and much valuable time is usually lost.

703. To the observant physician they speak another language. A contracted brow and a contracted pupil, with want of sleep at night, and want of quiet in the day, must never be overlooked.

704. Such are the true *cerebral* symptoms; but these are frequently allowed to proceed until some far more formidable symptom, belonging to the *excito-motory* system, supervenes. The *most frequent*, and the least formidable in appearance, amongst this second series of symptoms, is *vomiting*. We should *never* allow vomiting in an infant to pass without paying the utmost attention, and making the strictest inquiry, in reference to the functions of the brain. It is frequently the *first* symptom *noticed* of encephalitis, or hydrocephalus!

705. The next symptom belonging to the excito-motory division of the nervous system, is *strabismus*, a *contracted* state of the muscles of the *thumb* or *fingers*, or some unequivocal *spasmodic* or *convulsive* affection, of the *respiratory* muscles, or of the muscles of the *limbs*. No one *can* see the least of these things without the most extreme alarm.

706. These symptoms, from being apparently slight and transitory, become continuous and severe; the eye is affected

with strabismus, or is turned obliquely upwards, by the *tonic* action of the adducens, or the pathetic; or there is a rocking or rotatory motion of the eye, by the *clonic* action of the same nerves and muscles; the thumb is drawn spasmodically into the palm of the hand, and the fingers are closed over it; the toes are contracted towards the sole of the foot, and the arms are frequently affected with rigidity. There are *fits*, with spasmodic, croupy inspirations, from contraction of the glottis and action of the muscles of inspiration, or there are closure of the glottis and general *convulsions*.

707. The bowels are obstinately constipated.

708. These two series of cerebral and true spinal symptoms mark two distinct degrees of violence of this terrible malady.

709. The third stage is denoted by coma, and its concomitant diminution of the faculties of the sentient and voluntary system, and eventually of the powers of the excito-motory system:

710. There are blindness, deafness, deep stupor, the absence of voluntary motions. At the first, the eye-lids are constantly half closed, but *still* close completely on touching the eye-lash; afterwards, this excito-motory phenomenon ceases; the respiration becomes irregular, alternately *suspended, sighing,* and, at length, stertorous; the sphincters lose their power, and the fæces and urine are passed unconsciously.

711. The countenance is alternately slightly pale and slightly flushed, at the first; afterwards it is pale and emaciated.

712. The general surface is, like the countenance, cool, shrunk, and emaciated, in the later periods of the disease.

713. The pulse, which is slow at the first, becomes gradually more and more frequent and feeble, until, towards the close of the disease, it is counted with difficulty.

714. The tongue is white and loaded. The secretions are morbid; the alvine evacuations dark-coloured and fœtid.

715. How interesting and valuable would a series of cases be, taken in the rigid spirit of truth, and of the divisions of the nervous system into the cerebral, the true spinal, and the ganglionic!

716. The morbid anatomy of encephalitis consists in the effusion of serum and of lymph under the arachnoid, and of serum into the ventricles, and in softening of some part of the cerebral mass. Of the latter change, I saw an interesting case, a short time ago, in a child of two years of age.

717. The morbid anatomy of tuberculous hydrocephalus consists of the effusion of serum into the ventricles, and under the arachnoid at the summit, but especially at the base of the brain. M. Rufz has recently called the attention of the profession to peculiar, white, semi-transparent granulations, formed in the arachnoid, especially at the base of the brain. Tubercles occurred in the cerebrum or cerebellum in thirteen cases out of twenty-seven, in which these granulations were observed by M. Rufz. The spinal marrow and its membranes, examined in twelve cases, were found free from morbid change.

718. The connection between hydrocephalus and strumous affections has long been noticed. M. Rufz, in his interesting Thesis, states that tubercles of the lungs occurred in *every* case examined after their frequent coincidence with hydrocephalus had been distinctly ascertained. Granulations were observed in other organs,—the lungs, the pleura, the peritoneum, the liver, the kidneys.

719. The treatment of encephalitis, and of hypdrocephalus, in the *early* stage, and especially of encephalitis, must be energetically antiphlogistic.

720. Bloodletting, general and local, must be adopted in its fullest measure. The child should be placed in the perfectly erect position, and the jugular vein should be opened, and the blood be allowed to flow until the lips turn pale; afterwards, venesection, cupping, or leeches, should be employed, and repeated, according to the age and strength of the little patient, and the period and violence of the disease.

721. In regard to *bloodletting in infants*, I may observe, as the result of my experience, that the *first* bloodletting is well borne; but the subsequent bloodlettings require most careful watching. To open the jugular vein, to cup, to apply leeches, are the various modes of drawing blood. The child should be placed upright, and a certain effect should be produced, as a little pallor, in the *first* bloodletting; and then

the flow of blood should be instantly arrested, and the infant placed in the perfectly horizontal position. The *quantity* of blood which has flowed, with the effect on the symptoms, will guide us in regard to our subsequent proceedings, as explained in my "Observations on Bloodletting."

722. The bowels should be freely purged. The system should be brought under the influence of mercury as promptly as possible, by means of calomel, or the hydrargyrum cum cretâ, and the unguentum hydrargyri.

723. The head should be kept high, and bathed with a spirit lotion, or covered with a bladder partly filled with pounded ice. The feet should be fomented with hot water frequently, and kept warm. The diet should consist of barley-water. Every source of excitement or of disturbance should be carefully removed.

724. Later in the disease, counter-irritation, by blisters applied to the head or the neck, mercury, a more nutritious diet, and continued fomentations of the feet, may be tried.

725. I now proceed to treat of another form of encephalitis, or perhaps of congestion, and I cannot do so better than by introducing a most interesting case. It is that of

II. *Encephalitis (?) with Anasarca, after Scarlatina.*

726. I am indebted to Mr. Duffin for the opportunity of witnessing one of the most deeply interesting cases it has ever been my lot to treat.

727. A year and a half ago, Mr. Duffin took me to Highgate: we met Mr. Snow. The patient was a boy, aged twelve. Sixteen days before, he had gone through scarlatina, in its very mildest form; he had scarcely been confined to bed, and had not suffered from the *nimia medici diligentia;* he had appeared quite well.

728. On this Sunday morning he was seized with swelling of the face, which came on and increased equally suddenly and rapidly. With this symptom there was the appearance of sudden and serious collapse, and, soon afterwards, convulsions, followed by coma.

729. When I first saw my patient, there had been, first, the appearance of collapse and sinking, then convulsions, and these were followed by deep coma. Wine and brandy on the table

indicated sufficiently the previous state of the case. I felt persuaded, in spite of these appearances, that the only hope was afforded by relieving the vascular system within the head, and yet that the measure was not unattended with danger. This view was freely explained to the boy's father, who very sensibly said he confided his son's life to the hands of his medical advisers.

730. We placed the patient upright, and Mr. Duffin opened the jugular vein. I kept my finger on the pulse whilst we allowed *twenty ounces* of blood to flow! The convulsions ceased, and the coma diminished, but did not disappear. We then ventured to open a vein in the arm, and abstracted seven more ounces of blood!

731. In less than an hour the little patient knew his parents. We prescribed calomel and purgative medicine; a cold lotion to the head, and fomentations to the feet; afterwards leeches were applied; but the bloodletting was *the* remedy to which the amendment was obviously due. The little boy recovered forthwith, and, what is important, without the least symptom of the morbid effects of loss of blood.

732. I must here remark—1st, that acute anasarca and convulsions may, and frequently do, follow the mildest cases of scarlatina; perhaps, because, after *such* cases, less precaution is usually taken to clear the bowels; 2nd, that in all cases of acute anasarca there is the danger of an affection of the head, arachnitis, or congestion, coma, or convulsion; 3rd, that in such cases the remedy is bloodletting—*bloodletting until relief and security are obtained;* and 4th, that there is, in such cases, great *tolerance* of this remedy.

III. *The Hydrocephaloid Disease.*

733. I first gave a sketch of the hydrocephaloid disease in a little volume of "Medical Essays," published in 1825, but now out of print. It has since been *briefly* noticed by Dr. Abercrombie, in his valuable "Researches on Diseases of the Brain and Spinal Chord," published in 1828. I read an Essay upon it at the *Medico-Chirurgical Society*, on the 9th of December, 1828. Lastly, Dr. Gooch has treated of this affection in his excellent "Account of some Diseases peculiar to Women," published in 1829. These are all the

notices I have hitherto seen of this singular and interesting disorder.

734. The credit of having first distinguished this disease from hydrocephalus, has been given to Dr. Abercrombie and Dr. Gooch. These dates will, however, settle the questions both of priority and of originality.

735. The hydrocephaloid disease depends principally upon exhaustion. This exhaustion has its origin, in early infancy, chiefly in diarrhœa, or catharsis; in the later periods of infancy, in the loss of blood, with or without the relaxed or evacuated condition of the bowels. The state of diarrhœa has generally depended upon improper food, or intestinal irritation. It has very frequently succeeded to weaning, or to other changes in the diet, or to constipation. The catharsis has followed the administration of an aperient medicine, which, at such a moment of disorder of the stomach and bowels, is apt to act excessively. The exhaustion from loss of blood generally follows the inappropriate or undue application of leeches, or the use of the lancet.

736. I may observe, indeed, in this place, that, of the whole number of fatal cases of disease in infancy, a great proportion occur from this inappropriate or undue application of exhausting remedies. This observation may have a salutary effect in checking the ardour of many young practitioners, who are apt to think that if they have only bled, and purged, and given calomel enough, they have done their duty; when, in fact, in subduing a former, they have excited a new disease, which they have not understood, and which has led to the fatal result.

737. This question, and that of the effects of exhaustion in infants and children, open a new field of investigation. Almost all our works on infantile diseases are silent on the subject; and yet without an accurate knowledge of it, I regard it as totally impossible that we should be prepared to watch and treat the morbid affections of this young and tender age. The subject must be taken up and investigated anew. All the affections which may rise from exhaustion, must be accurately observed, distinguished from similar affections arising from a variety of other causes, and traced back to their origin, and forward in relation to their remedies. In

this manner some *hydrocephaloid, convulsive,* and even *croupy* affections will be viewed in a new aspect; and we shall be preserved from some painful dilemmas into which we should assuredly fall without this knowledge of the effects of exhaustion.

738. This affection may be divided into two stages: the first, that of irritability; the second that of torpor. In the former there appears to be a feeble attempt at reaction; in the latter the powers appear to be more prostrate. These two stages resemble, in many of their symptoms, the first and second stages of hydrocephalus respectively.

739. In the first stage the infant becomes irritable, restless, feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched, or from any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered.

740. If, through an erroneous notion as to the nature of this affection, nourishment and cordials be not given, or if the diarrhœa continue, either spontaneously, or from the administration of medicine, the exhaustion which ensues is apt to lead to a very different train of symptoms. The countenance becomes pale, and the cheeks cool or cold; the eye-lids are half closed, the eyes are unfixed, and unattracted by any object placed before them, the pupils unmoved on the approach of light; the breathing, from being quick, becomes irregular and affected by sighs; the voice becomes husky, and there is sometimes a husky, teasing, cough; and, eventually, if the strength of the little patient continue to decline, there is a crepitus or rattling in the breathing; the evacuations are usually green; the feet are apt to be cold.

741. A similar train of symptoms occurs in other cases, in which the strength of the little patient has been subdued and the vascular system exhausted by the abstraction of blood. In both cases, leeches are sometimes again applied to subdue this new form of disease, under the erroneous notion of a primary cerebral affection. This measure infallibly plunges the little patient into imminent, if not irretrievable danger. Sometimes the sinking state goes on in spite of every appro-

priate remedy. Stimuli, if efficacious, reduce the frequency of the pulse, and restore the wonted warmth, colour, expression, and smiles to the countenance.

742. The condition of the cheeks, in regard to colour and warmth, may be considered as the pulse of very young infants, indicating the degree of remaining power, or of exhaustion. In the present case, especially, there is no symptom so important, so distinctive. It is from the condition of the cheeks, in conjunction with a due consideration of the *history*, that the diagnosis of this morbid state, and the indication of the appropriate remedies, are chiefly to be deduced. The general surface, and especially the hands and feet, also afford important sources of information as to the condition of the nervous or vital powers. Next to these, the degree of frequency of the pulse, and the character of the breathing, are points of the greatest importance; during the stage of irritability, the breathing is quick; during that of torpor, it is slower, irregular, suspirious, and, finally, crepitous; the pulse changes in its beat, from being full becoming smaller, but retaining, perhaps, its former frequency.

743. We should be especially upon our guard, not to mistake the stupor, or coma, into which the state of irritability is apt to subside, for the natural sleep, and for an indication of returning health. The pallor and coldness of the cheeks, the half-closed eye-lid, and the irregular breathing, will sufficiently distinguish the two cases.

744. This brief sketch of the symptoms, in this interesting infantile affection, is taken from my Essay published upon the subject some years ago. I have recently had a most interesting opportunity of observing the symptoms in an extreme case, although followed by perfect recovery.

745. The patient, a little boy, aged four, became comatose, and perfectly blind and deaf. The finger might approach the half-closed eye without inducing any movement; but the moment it touched the eye-lash, the eye-lids closed. A spoon applied to the lips excited their action, and the fluid it contained was conveyed into the pharynx and swallowed. The respiration was frequently suspended; a sigh and frequent respiration followed. The cerebral functions had ceased; the true spinal functions remained.

746. In another case of a little girl, one year old, the eyelids ceased to close, even when the eye-lash or the eye-ball was touched. Yet the recovery took place under the prompt and efficient exhibition of stimuli.

747. The remedies for this morbid affection are such as will check the diarrhœa, and afterwards regulate the bowels, and restore and sustain the strength of the little patient. With the first objects, it may be necessary to give the tinctura opii, and chalk, and, afterwards, the pilula hydrargyri, rhubarb, and magnesia; with the second, sal volatile, but especially brandy; and proper nourishment, are to be given according to circumstances. But in this, as in many cases of infantile disorders, the milk of a young and healthy nurse is the remedy of most importance; in the absence of which, ass's milk may be tried, but certainly not with the same confident hope of benefit.

748. Five or ten drops of the sal volatile may be given every three or four hours; and twice or thrice in the interval, five or ten drops of brandy may be given in arrow-root done in water. As the diarrhœa and appearances of exhaustion subside, these remedies are to be subtracted, the bowels are to be watched and regulated, and the strength is to be continually sustained by the nurse's or ass's milk. The brandy has sometimes appeared to induce pain; sal volatile is then to be substituted for it; a dose of magnesia has also appeared to do good.

749. For the state of irritability, the warm bath is a remedy of great efficacy. For the coma, a small blister, or sinapism, should be applied to the nape of the neck. A state of exhaustion of the general system, as I have observed elsewhere, by no means precludes the possibility of real congestion of the brain. It rather implies it. In extreme cases, there are not only the symptoms of cerebral congestion during life, but effusion of serum into the ventricles of the brain is found on examination after death.

750. In every case, the extremities are to be kept warm by flannel, and the circulation should be promoted in them by assiduous frictions. It is of the utmost importance carefully to avoid putting the little patient into the erect

posture. A free current of air is also a restorative of the greatest efficacy.

751. Having thus given a sketch of the hydrocephaloid disease, as it has presented itself to my own observation, I think it will be interesting to show what have been the results of the observations of others, and especially of Dr. Abercrombie, and of the late Dr. Gooch. I have been told, indeed (Brit. and For. Med. Rev. for April, 1837, p. 325), that an observation made by the former eminent physician in an early volume of the Edinb. Med. and Surg. Journal (for Nov. 1818), vol. xiv, p. 581), preceded mine. I mention this circumstance to show that I have no disposition to claim more than is justly due to me. I must add, however, that Dr. Abercrombie's observation, which was entirely unknown to me, was but an isolated paragraph of a few lines, and, for that reason, however interesting, little calculated to seize the attention of practitioners. Mine was a distinct treatise, under a new and appropriate designation. Does any one think that Dr. Wells's brief account of the disease of the kidney with albuminous urine, in the Transactions of a Society for the Improvement of Medical Knowledge (vol. iii, p. 194), and M. Andral's account of the same disease, in his "Clinique Médicale," ed. 1, t. ii, p. 567, deprive Dr. Bright of the merit, even of originality, in his full description of that disease? No. The cases are precisely parallel, except that Dr. Wells's and M. Andral's accounts are much more than mere incidental paragraphs. Nevertheless, Dr. Bright enjoys, most justly, the well-merited reputation of having made a most important addition to our knowledge in pathology.

752. Dr. Abercrombie observes, in 1828,—"In the last stage of diseases of exhaustion, patients fall into a state resembling coma, a considerable time before death, and whilst the pulse can be felt distinctly. I have many times seen children lie for a day or two in this kind of stupor, and recover under the use of wine and nourishment. It is often scarcely to be distinguished from the coma which accompanies diseases of the brain. It attacks them after some continuance of exhausting diseases, such as tedious or neglected diarrhœa; and the patients lie in a state of insensibility, the pupils di-

lated, the eyes open and insensible, the face pale, and the pulse feeble. It may continue for a day or two, and terminate favorably, or it may prove fatal. This affection seems to correspond with the apoplexia ex inanitione of the older writers. It differs from syncope in coming on gradually, and in continuing a considerable time, perhaps a day or two; and it is not, like syncope, induced by sudden and temporary causes, but by causes of gradual exhaustion, going on for a considerable time. It differs from mere exhaustion, in the complete abolition of sense and motion, whilst the pulse can be felt distinctly, and is in some cases of tolerable strength. I have seen in adults the same affection, though it is, perhaps, more uncommon than in children." In a letter which I had the honor to receive from Dr. Abercrombie, that gentleman observes—" The state of infants which I have referred to, is a state of pure coma, scarcely distinguishable, at first sight, from the perfect stupor of the very last stage of hydrocephalus, the child lying with the eyes open, or half open, the pupils dilated, the face pale. It is difficult to describe distinctly the appearance; but it is one which conveys the expression of coma, rather than of sinking; and I remember, the first time I met with the affection, the circumstance which arrested my attention, and led me to suppose the disease was not hydrocephalus, and the state somewhat differing from coma, was finding, on further inquiries, that it came on after diarrhœa, and not with any symptoms indicating an affection of the head. The child recovered under the use of wine and nourishment."

753. Effects somewhat similar are apt to follow operations on very young children. See Mr. Travers's interesting work upon " Constitutional Irritation," pp. 139—141, published in 1826.

754. Dr. Gooch observes—" I am anxious to call the attention of medical men to a disorder of children which I find invariably attributed to, and treated as, congestion or inflammation of the brain, but which, I am convinced, often depends on, or is connected with, the opposite state of circulation. It is chiefly indicated by heaviness of head and drowsiness. The age of the little patients whom I have seen in this state, has been from a few months to two or three years;

they have been rather small of their age, and of delicate health; or they have been exposed to debilitating causes. The physician finds the child lying on the nurse's lap, unable or unwilling to raise its head, half asleep, one moment opening its eyes, and the next closing them again, with a remarkable expression of languor. The tongue is slightly white, the skin is not hot; at times the nurse remarks that it is colder than natural. In some cases there is, at times, a slight and transient flush; the bowels I have always seen already disturbed by purgatives, so that I can scarcely say what they are when left to themselves: thus the state which I am describing is marked by heaviness of the head, and drowsiness, without any signs of pain, great languor, and a total absence of all active febrile symptoms. The cases which I have seen have been invariably attributed to congestion of the brain; and the remedies employed have been leeches and cold lotions to the head, and purgatives, especially calomel. Under this treatment they have gradually become worse; the languor has increased; the deficiency of heat has become greater and more permanent; the pulse quicker and weaker; and at the end of a few days, or a week, or sometimes longer, the little patients have died, with symptoms apparently of exhaustion. In two cases, however, I have seen, during the last few hours, symptoms of oppressed brain, as coma, stertorous breathing, and dilated and motionless pupil."

755. But, although this morbid affection is scarcely described by former writers, it is, I find, sufficiently familiar to many observing practitioners, on recalling to their minds the circumstances of the singular and interesting state of things attending it; and I am indebted to several friends for notices of cases of this kind.

756. I proceed to exemplify this description, and the appropriate treatment, by adducing several cases. The first I give from my "Medical Essays."

757. *Case* 1.—"A little girl, aged four months, was seized with a bowel complaint; the usual medical attendant prescribed an aperient, which acted too freely. When I saw it on the second or third day of the disorder, the countenance was pale and sunk, and the cheeks cool; it started on being touched; there was a peculiar huskiness of the voice; and

the pulse beat from 144 to 150. By giving brandy, the pulse was found, on the succeeding day, reduced to 120, and there was some apparent amendment, although a degree of rattling in the breathing, or on coughing, was now added to the huskiness of the voice. By continuing the brandy, the cheeks became warm, and at length somewhat flushed, and the pulse rose to 140. The quantity of brandy was diminished, and cautiously regulated, and the pulse very gradually fell to the natural standard.

758. "In this case, the pallidness and coldness of the cheeks, and the state of the voice and breathing, indicated almost a fatal degree of exhaustion: the frequency of the pulse, arising from this cause, was reduced by the brandy; but it was afterwards again increased, as the effect, not of the exhaustion, but of the stimulus, and the cheeks recovered their warmth, and sometimes even became flushed. In another case, precisely similar, the state of sinking continued in spite of every remedy, and the little infant lingered, and then expired. I have known such a state of lingering to be continued for several days."

759. *Case* 2.—On Sunday, the 21st of March, I was called to an infant, three months old, under the following circumstances:—It had been weaned a fortnight; during this period it had been fed with milk and barley-water, and once a day with the addition of bread. It remained well until the Thursday before my visit, when it became affected with fever, restlessness, crying, and moaning in its sleep, and with diarrhœa, passing several undigested and mucous stools. A dose of calomel was given, which induced sickness. A second dose was then administered, which, in the course of that and the succeeding day, Friday, was followed by sixteen evacuations.

760. During Friday night there was much heat, interrupted sleep, and griping pains, followed by offensive evacuations. On the following morning there was some degree of dozing, or coma; the eyes were imperfectly closed, the tunica albuginea alone being visible, and the mouth was open. This inanimate state, attended by coldness of the cheeks, hands, and feet, would continue for ten minutes, and then there would be some degree of re-action.

761. This state of things continued during the whole of Saturday, the dozing assuming the character of more settled coma. I saw the little patient late in the evening. The cheeks were then pale and cold; the eyes were half open and unfixed, and unexcited by any external object, however brilliant, and the pupils were moderately dilated, and unmoved on the approach of light; the pulse was 132; the breathing irregular and sighing; the general surface pale, and the hands and feet cold.

762. There were thus the usual symptoms of the comatose stage of hydrencephalus. The condition of the countenance, general surface, and extremities, and the history of the case, however, led me to view it as one of exhaustion, and not of inflammation and effusion within the head. I therefore prescribed five drops of brandy, and three of sal volatile, to be given alternately every hour; and I directed the little patient to be put once, in the interval of two hours, to the breast of a young and healthy nurse.

763. Under this discipline there was a gradual, but not unchequered, amendment. The stupor began to alternate with restlessness, and there were frequent startings; more than once the restlessness was so great as to require the use of the warm bath, by which it was greatly relieved, and quiet and sleep induced. The countenance gradually assumed a more natural and animated appearance and expression, with an occasional smile. The bowels were moved four times on the succeeding day, the evacuations being great.

764. On Monday morning, a little magnesia and rhubarb were given, the other remedies having been, and being still continued. The little patient started much less on this day, and slept quietly, and there was no return of restlessness to require the warm bath.

765. On the succeeding days there was an obvious and progressive amendment. The brandy and sal volatile were gradually abstracted, the breast being continued.

766. *Case* 3.—I was called, a short time ago, to see a little girl, aged two years and three quarters, who had laboured under an attack of influenza. The affection of the chest had been severe and protracted, and sixteen leeches had been applied, besides the administration of other depletory measures, before it had subsided.

767. The symptoms of affection of the chest were, however, subdued at last; but the little patient was left extremely exhausted; and in this state a new train of symptoms supervened, not less alarming, and more puzzling, than the first. The child fell into a dozing state, and lay with its eye-lids but half closed; it moaned when any attempt was made to rouse it; the eyes were unfixed on any external object, the pupils were dilated, yet partially contractile on the influx of light; the pulse was 140.

768. On withdrawing into an adjoining room, the medical gentleman whom I had the pleasure of meeting observed, "hydrencephalus has now supervened, and we must administer calomel." I replied, that I took a different view of the case,—that it resembled hydrencephalus, indeed, but arose from exhaustion, and that brandy, not calomel, would alone save the little patient's life. I referred to the history of the case for sufficient sources of exhaustion; and to the facts detailed in the preceding part of this paper, for the actual occurrence of such cases in practice.

769. We administered brandy, directing thirty drops to be given every two hours, with barley-water in the intervals, and a quarter of a pint of ass's milk twice in the twenty-four hours. The bowels were relieved by magnesia and the warm water injection.

770. This plan of treatment lowered the number of the pulse, and gradually diminished the severity of the other symptoms. Still the eyes were not to be fixed by presenting any bright object before them; the pupils remained dilated; the tunica conjunctiva became inflamed from exposure between the partially-closed eye-lids; and once or twice the fæces were passed involuntarily in bed.

771. The brandy having occasioned pain in the bowels, an effect which I have several times observed, it was given alternately with the spiritus ammonia aromaticus. The rest of the plan was pursued with unexampled assiduity by a most tender mother, who did not once undress, or leave her little patient, until she saw it out of all danger. This task was the severer, because, although the symptoms which had been detailed subsided gradually and favourably, they were succeeded by an equally severe and sadly protracted aphthous affection.

772. The first symptom of amendment was a diminished frequency of the pulse; the next a restored susceptibility of the pupils to light; then the eyes became attracted and fixed by external objects, and a smile began to play upon the little patient's countenance; the eyelids closed more and more perfectly during sleep, and the conjunctivæ lost their inflamed, injected appearance; the knees were drawn up, and the posture on the side began to be assumed spontaneously.

773. I have notes of two other cases of this kind; but they are so precisely similar to those which I have given, that it appears needless to add to the length of the present chapter by relating them in detail. I shall rather adduce the further evidence contained in the paragraph of a letter written to me by my friend Dr. Heming.

774. "The two little children of whom I spoke to you became affected with bowel complaint; and the usual medical attendant gave them some aperient medicine. As they continued to get worse, Dr. Blegborough was consulted. I saw them on December 10th, 1826.

775. "The youngest, an infant aged nine months, was suffering from aphthous diarrhœa, was very pale and much emaciated, and appeared to be dying. It lingered for two or three days with the symptoms of sinking which you have described, and then expired. The eldest child, a girl aged three years, the principal subject of the short account which I am enabled to give you, had had leeches applied to the temples, and taken calomel and jalap, and its mother was, at the time I saw it, applying a cold spirit lotion to the head. Dr. Blegborough had given it as his opinion that the case was hydrencephalus, and, of course, hopeless; and, in truth, I thought he was right, for the child was completely insensible to sound or light; the eyes were half closed, and affected with strabismus, and the pupil dilated; its head fell from side to side, and the fæces passed involuntarily; the skin was blanched, and there was great emaciation. I recommended sinapisms to be applied to the feet; and, if the child should become capable of swallowing, which I did not expect, to give it ass's milk, and to omit all medicine.

776. "When I called on the 12th, I was greatly and agreeably surprised to find this little patient much better.

The ass's milk had been taken, and seemed to agree. As the bowels were still moved frequently and involuntarily, and as I did not now think the symptoms depended upon effusion into the brain, though I confess I was much puzzled to know to what cause they were to be assigned, I recommended small doses of laudanum to be given until the diarrhœa should be checked. On the 14th, the motions were less frequent, and the little patient was better in every respect. On the 18th, although very pale, the child was still further improved. It was sent into the country; and a few months afterwards it was perfectly well."

777. For the following case I am indebted to Dr. Tweedie:

778. "In September last I was requested by a respectable medical practitioner to visit an infant which he suspected to be dying from effusion into the brain. On reaching the house, I found a little child, about four months old, lying in a state of complete coma, from which it could not be roused. On raising the eye-lids, the pupils were found natural, though the eye was dull. The pulse was rapid and feeble; the breathing frequent, and occasionally interrupted and suspirious; and the bowels were loose, the evacuations consisting chiefly of mucus.

779. "On enquiring into the previous history, I was informed, that the mother, having accepted the situation of wet-nurse in a family, had placed this child, which was then in perfect health, under the care of another nurse, who had just weaned her own child, at the age of nine months; that very soon afterwards it began to be sick, and the bowels became relaxed; and, as it did not get better, it was removed to the house of a relation, who attempted to rear it by spoon-diet. It was soon observed to rally under this change; but the diarrhœa continued in spite of remedies administered with the view of checking it. Ten days afterwards, it became again fretful and uneasy, the bowels being still purged; then coma gradually supervened; and it died nine days afterwards, within twelve hours of my visit.

780. "Permission could not be obtained to examine the body."

781. It was after my paper was read to the *Medico-Chirurgical Society*, that I had the satisfaction of seeing the

publication of the late Dr. Gooch, in which that acute physician has given cases similar to those just detailed. I cannot but be sensible of the flattering manner in which he alluded to my observations.

782. As the cases and remarks of Dr. Gooch contain the only ones relating to the present subject which I have found in medical writings, I think it important to add some of them to those which I have already deduced from my own observation and that of the gentlemen already quoted:

783. "A little girl, about two years old, small of her age, and very delicate, was taken ill with the symptoms which I have above described. She lay dozing, languid, with a cold skin, and a pulse rather weak, but not much quicker than natural. She had no disposition to take nourishment. Her sister having died only a week before of an illness which began exactly in the same way, and which was treated by leeches and purgatives, and some doubts having been entertained by the medical attendant of the propriety of the treatment, leeches were withheld; but the child not being better at the end of two days, the parents, naturally anxious about their only surviving child, consulted another practitioner. The case was immediately decided to be one of cerebral congestion; and three leeches were ordered to be applied to the head. As the nurse was going to apply them, and during the absence of the medical attendants, a friend called in who had been educated for physic, but had never practised it, and who had great influence with the family; he saw the child, said that the doctors were not sufficiently active, and advised the number of leeches to be doubled. Six, therefore, were applied; they bled copiously; but, when the medical attendants assembled in the evening, they found the aspect of the case totally altered, and that for the worse: the child was deadly pale, it had scarcely any pulse, its skin was cold, the pupils were dilated, and motionless when light was allowed to fall on them, and, when a watch was held to its eyes, it seemed not to see; there was no squinting. Did this state of vision depend on the pressure of a fluid effused into the brain since the bleeding, and during this exhausted and feeble state of circulation, or did it depend on the circulation of the brain being too languid to support the sensibility of the retina? It

is well known that large losses of blood enfeeble vision. I saw a striking instance of this in a lady who flooded to death. When I entered the chamber, she had no pulse, and she was tossing about in that restless state which is so fatal a sign in these terrific cases. She could still speak, asked whether I was come (she knew I had been sent for), and said, 'Am I in any danger? How dark the room is! I can't see.' The shutters were open, the blind up, and the light from the window facing the bed fell strong on her face. I had the curiosity to lift the lid and observe the state of the eye: the pupil was completely dilated and perfectly motionless, though the light fell strong on it. Who can doubt that here the insensibility of the retina depended on the deficiency of its circulation? But to return to the little patient. The next day she had vomited her food several times: it was therefore directed that she should take no other nutriment than a dessert-spoonful of ass's milk every hour; and this was strictly obeyed, and continued for several days. The child wasted, her features grew sharp, and every now and then she looked fretful, and uttered a faint, squeaking cry; the eye-balls became sunk in the socket, like those of a corpse that had been dead a month; the skin continued cool, and often cold, and the pulse weak, tremulous, and sometimes scarcely to be felt. Under this regimen, and in this way, she continued to go on for several days. At times she revived a little, so as to induce those who prescribed this treatment to believe confidently that she would recover; and she clearly regained her sight; for, if a watch was held up to her, she would follow it with her eyes. She lived longer than I expected, a full week, and then died with the symptoms of exhaustion, not with those of oppressed brain. The head was opened by a surgeon accustomed to anatomical examinations, and nothing was found but a little more serum than is usual in the ventricles.

784. "If the reader has perused the foregoing case attentively, and has reflected on it, he will, of course, draw his own inferences. I can draw no others than these, that the heaviness of head and drowsiness, which were attributed to congestion in the brain, really depended on a deficiency of nervous energy; that the bleeding and scanty diet aggravated this state, and insured the death of the child; also, that the

state of the eye which so speedily followed the loss of blood, and which resembled that occasioned by effusion, did in reality depend on a deficiency of circulation of the brain: a fact of considerable curiosity and importance.

785. "I will now relate a case similar in the symptoms, but very different in the treatment and results. I was going out of town one afternoon last summer, when a gentleman drove up to my door in a coach, and intreated me to go and see his child, which he said had something the matter with its head, and that the medical gentleman of the family was in the house, just going to apply leeches. I went with him immediately, and when I entered the nursery I found a child, ten months old, lying on its nurse's lap, exactly in the state which I have already described: the same unwillingness to hold its head up, the same drowsiness, languor, absence of heat, and all symptoms of fever. The child was not small of its age, and had not been weak, but it had been weaned about two months, since which it had never thriven. The leeches had not been put on. I took the medical gentleman into another room, related to him the foregoing case, and several similar to it, which had been treated in the same way, and had died in the same way. Then I related to him a similar case which I had seen in the neighbouring square, which had been treated with ammonia in decoction of bark, and good diet, which had recovered; not slowly, so as to make it doubtful whether the treatment was the cause of the recovery, but so speedily that at the third visit I took my leave. He consented to postpone the leeches, and to pursue the plan which I recommended. We directed the gruel diet to be left off, and no other to be given than ass's milk, of which the child was to take at least a pint and a half, and at most a quart, in twenty-four hours. Its medicine was ten minims of the aromatic spirit of ammonia in a small draught every four hours. When we met the next day, the appearance of the child proved that our measures had been right; the nurse was walking about the nursery with it upright in her arms; it looked happy and laughing. The same plan was continued another day; the next day it was so well that I took my leave, merely directing the ammonia to be given at longer intervals, and thus gradually withdrawn. The

ass's milk to be continued, which kept the bowels sufficiently open without aperient medicine.

786. "So inveterate is the disposition to attribute drowsiness in children to congestion of the brain, and to treat it so, that I have seen an infant, four months old, half dead from the diarrhœa produced by artificial food, and capable of being saved only by cordials, aromatics, and a breast of milk; but because it lay dozing on its nurse's lap, two leeches had been put on the temples, and this by a practitioner of more than average sense and knowledge. I took off the leeches, stopped the bleeding of the bites, and attempted nothing but to restrain the diarrhœa and get in plenty of nature's nutriment; and as I succeeded in this, the drowsiness went off and the child revived. If it could have reasoned and spoken, it would have told this practitioner how wrong he was. Any one who, from long defect in the organs of nutrition, is reduced so that he has neither flesh on his body nor blood in his veins, well knows what it is to lay down his head and doze away half the day without any congestion or inflammation of his brain. This error, although I have specified it only in a particular complaint of children, may be observed in our notions and treatment of other diseases, and at other periods of life. If a woman has a profuse hæmorrhage after delivery, she will probably have a distressing headach, with throbbing in the head, noises in the ears, a colourless complexion, and a quick, weak, often-thrilling pulse, all which symptoms are greatly increased by any exertion. I have seen this state treated in various ways, by small opiates, gentle aperients, and unstimulating nourishment, with no relief. I have seen blood taken away from the head, and it has afforded relief for a few hours; but then the headach, throbbing, and noises, have returned worse than ever. The truth is, that this is the acute state of what, in a minor degree, and in a more chronic form, occurs in chlorosis, by which I mean pale-faced amenorrhœa, whether at puberty or in after-life. It may be called acute chlorosis, and like that disease is best cured by steel, given at first in small doses, gradually increased, merely obviating constipation by aloetic aperients.

787. "I shall not encumber this paper with a multiplicity of cases, but state the above are only specimens of a class of

which I have seen enough to convince me that they deserve the attention of the profession. If I had any doubt about this, this doubt would be removed by the fact that Dr. Marshall Hall has already recognised them, and described them in a paper which has been read at the *Medico-Chirurgical Society*. He has, therefore, anticipated me in announcing them. The only difference between our experience seems to be this, that he attributes the state which I have been describing to the diarrhœa produced by weaning, or to the application of leeches for some previous complaint. In most of the cases I have seen, however, the child has had no previous illness, and the leeches have been applied subsequent to the drowsiness, and as a remedy for it."

788. In regard to the difference in the experience of Dr. Gooch and myself, I would observe, that that of Dr. Abercrombie plainly concurs with mine, and that, in all cases seen by Dr. Gooch himself, the bowels had already been disturbed by purgatives, so that a source of exhaustion had existed in them. All the cases which I have seen or heard of, and those of Dr. Heming and of Dr. Tweedie, alike involved a state of exhaustion.

789. The first stage of the affection which had been described, or that of irritability, may, indeed, depend on a previous disordered condition of the stomach and bowels; but the state of torpor is obviously the result of exhaustion.

790. The rest of Dr. Gooch's observations are highly interesting.

791. I possess other cases of this interesting disease. One I visited some years ago with Dr. James Johnson and Mr. Balderson; another was the infant son of Mr. Michele, now a fine boy; a third was the nephew of Mr. Fleetwood; a fourth I visited but the other day with Mr. Vickers; and a fifth still more recently, with Mr. Liddell.

792. If my account of this affection appears disproportionately long, I must apologise by appealing to the novelty and importance of the subject,—of the diagnosis between this affection and encephalitis, which it so nearly resembles, and of the difference of the treatment. I shall *conclude* by briefly detailing the interesting case of the son of my neighbour, Mr. Howlett, of Thayer Street, whom I attended in consultation with Mr. Grant.

793. The little patient was four years old, and laboured under symptoms which seemed to denote the existence of hydrocephalus. There was a state of stupor; the eye-lids were only partially closed, and they were immoveable on the approach, and actual contact, of the finger; the respiration was irregular, and the pulse frequent. I observed that the phenomena presented by the eye-lids would afford a criterion which would suggest both the diagnosis and prognosis. The history, and the cool and pale condition of the cheeks, suggested the hope that the symptoms depended more upon exhaustion, than actual disease within the head. I ventured to give sal volatile, brandy, and nourishment. We had, in a short time, the pleasure of observing the eye-lids become impressible to the stimulus of the finger, the respiration to become regular, and the gradual recovery of the little patient was no longer doubtful.

IV. *The Croup-like Convulsion.*

794. If the very existence of the *hydrocephaloid* disease was unknown to the profession previously to my researches, the *nature* of that of which I now proceed to speak, the *croup-like* disease, could not be understood until the reflex modes of action of the excito-motory property, with the *system* of the true spinal marrow, and its incident and reflex nerves, were demonstrated.

795. The origin of this disease, to which I will not at present give a name, was erroneously referred to the cerebrum by the late Dr. J. Clarke, to whom we owe its detection; and to compression and consequent paralysis of the pneumogastric and its recurrent nerves, by the late Dr. Hugh Ley, to whom we are indebted for an otherwise invaluable treatise upon it. It is, in reality, an excitation of the true spinal or excito-motory system. It *originates* in

I. 1. *The Trifacial,* in teething;
   2. *The Pneumogastric,* in over- or improperly- fed infants;
   3. *The Spinal nerves,* in constipation, intestinal disorder, or catharsis. These act through the medium of

II. *The Spinal Marrow*, and

III. 1. *The Inferior* or *Recurrent Laryngeal*, the constrictor of the larynx;

2. *The Intercostals* and *Diaphragmatic*, the motors of respiration.

796. *This* mode of viewing an important disease and *Class* of diseases is entirely new, and is the only true one. It points, too, to the *causes* and the *cure*. It is represented in the interesting diagram in *Plate* VI, *fig.* 2, and it is further illustrated by the following

TABLE OF THE CROWING INSPIRATION.

I. *The Excitors.*	II. *The Centre.*	III. *The Motors.*
1. *The Trifacial.*	*The Medulla oblongata.*	1. *The Recurrent of the Pneumogastric.*
2. *The Pneumogastric.*		2. *The Intercostals.*
3. *The Spinal.*		3. *The Diaphragmatic.*

797. When the *crowing inspiration* passes into actual *convulsion*, the larynx, from being *partially*, becomes *perfectly closed*, and there are violent *expiratory* efforts, with consequent congestion of the encephalon, and all its terrific train of evils!

798. The same mode of viewing this important subject leads us to give its proper place to *each* of the series of symptoms: the *spasmodic* or *spinal* are the *first* in order; the *cerebral* the *second*. We are thus enabled to see the just relation and position of effusion into the ventricles of the brain in regard to this disease; it is the *effect*, not the *cause*.

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799. But I proceed with the *practical* view of the subject.

800. The principal *causes* of the croupy convulsion in children, in a practical point of view, are,

1. *Dental Irritation.*
2. *Gastric Irritation.*
3. *Intestinal Irritation.*

801. And here I must make the important, the all-important, practical remark, that I have *never* seen the measures

suggested by this view of the causes, when *early* and *effectually* enforced, fail in remedying this disease.

802. Besides these especial causes, there are others which act upon the nervous centres. Passion, vexation, and certain odours, are of this class; and, singular as it may appear, the state of sleep *predisposes*, at least, to attacks of this kind of convulsion.

803. It is interesting to observe how the series of *symptoms* in the covulsions of infants are affections of the excito-motory functions.

804. Amongst the most frequent of the symptoms is *strabismus;* in a second case we may have contractions of the thumb and fingers, of the wrists, and of the toes and feet; next comes that affection of the *larynx* and of the muscles of *inspiration*, which has been so well described by the late Dr. John Clarke, as a "peculiar species of convulsion;" in other cases the *larynx* is actually *closed*, and there are an expression of fright, and, sometimes, retraction of the head, and violent convulsive *expiratory* efforts; in a fifth case there is an affection of the *sphincters* of the bladder and intestine, even leading to the idea of calculus.

805. One or more of these symptoms, or a sardonic smile, lead to a general *convulsion*.

806. Strabismus is the first of the symptoms which I have enumerated. Like the rest, it is sometimes acute, sometimes chronic in its character. The eye is turned inwards, most frequently; sometimes obliquely. The strabismus is variable, obviously augmented by teething, improper food, constipation or fret of the bowels, &c. and it is relieved by relieving these states of irritation. It is equally obviously increased by nervous agitation, by calling the muscles into greater action than usual, &c.

807. Very similar to the undue action of the muscles of the eye, inducing strabismus, is that of the muscles of the fingers and toes, inducing clenched hands and contraction of the feet. This affection is noticed by Underwood and Clarke, and particularly by the late Dr. Kellie of Leith, in an early volume of the Edinburgh Med. and Surg. Journal. It is augmented by causes similar to those which augment strabismus. It is, like strabismus, apt to assume a chronic character, and it

always constitutes a symptom portentous of other forms of spasmodic and convulsive affection.

808. The peculiar convulsion described by Dr. Underwood, and especially by Dr. John Clarke, must next be noticed. Dr. Underwood describes it as combining a little blueness of the lips, slight turning up of the eyes, a *peculiar sound of the voice* (somewhat like *croup*), and a very quick breathing at intervals, frequently coming on during sleep, or any exertion of the body, or transient surprise.

809. Dr. J. Clarke's description of this disease is highly interesting. He observes :—

810. " This convulsive affection occurs by paroxysms, with longer or shorter duration in different cases, and in the same case at different times.

811. " It consists in a peculiar mode of inspiration, which it is difficult accurately to describe.

812. " The child, having had no apparent warning, is suddenly seized with a spasmodic inspiration, consisting of distinct attempts to fill the chest, between each of which a squeaking noise is often made; the eyes stare, and the child is evidently in great distress; the face and extremities, if the paroxysm continues long, become purple, the head is thrown backwards, and the spine is often bent, as in opisthotonos; at length a strong expiration takes place, a fit of crying generally succeeds, and the child, evidently much exhausted, often falls asleep.

813. " In one of these attacks a child sometimes, but not frequently, dies.

814. " They usually occur many times in the course of the day, and are often brought on by straining, by exercise, and by fretting; and sometimes they come on from no apparent cause.

815. " They very commonly take place after a full meal, and they often occur immediately upon waking from sleep, though, before the time of waking, the child had been lying in a most tranquil state. As the breathing is affected by these paroxysms, the complaint is generally referred to the organs of respiration, and it has been sometimes called chronic croup; but is very different from croup, and is altogether of a con-

vulsive character, arising from the same causes, and is relieved by the same remedies as other convulsive affections.

816. "Accompanying these symptoms, a bending of the toes downwards, clenching of the fists, and the insertion of the thumbs into the palm of the hands, and bending the fingers upon them, is sometimes found, not only during the paroxysms, but at other times.

817. "Clenching the fist with the thumb inserted into the palm of the hand, often exists for a long time in children without being much observed; yet it is always to be considered as an unfavourable symptom, and frequently is a forerunner of convulsive disorders, being itself a spasmodic affection.

818. "It rarely happens that a child recovers from an attack of this sort, unless the progress of the disorder has been interrupted by a timely application of proper remedies without a general convulsion. Then the friends become alarmed, and a disease which had existed for two or three months, is, for the first time, considered to be important enough to require medical assistance, after all the farrago of popular medicines, such as fit-drops, soot-drops, assafœtida, &c. have been ineffectually applied.

819. "Convulsions of this description seldom, if ever, occur after the expiration of the third year of a child's life, and not often in children which have lived by sucking till they have teeth, and have never taken animal food till the dentes cuspidati have come through the gums; this, however, is liable to some exceptions."

820. The next question is that of the *nature* of this affection; and, in discussing this question, I must particularly notice the opinion of the late Dr. J. Clarke, that it is *cerebral* in its origin; and of the late Dr. Hugh Ley, that it arises from the compression of enlarged glands upon the *pneumogastric* nerve.

821. In reference to the opinion of the *cerebral origin* of this disease, I may observe:—

822. 1. That the *changes* in the symptoms, whether for better, or for worse, are far too sudden to be dependent on *disease* within the head.

823. 2. That the *effects* of its causes and of its remedies

are of a character totally different from what would be seen in such disease.

824. 3. That hydrocephalus,—I mean tubercular hydrocephalus,—does not commonly produce the croup-like convulsion. This statement must, however, be received with caution, and be submitted to new observation. Compare § 712.

825. Meantime I may add the following remark with which I have been favoured by Dr. P. Hennis Green. This gentleman observes:—

826. "I have looked over sixty-six cases of acute and chronic meningitis occurring in children, which I possess in manuscript, and do not find a single example of the coexistence of 'crowing inspiration.' Most of the cases were examples of the 'tubercular' form. It should, however, be remarked that all were cases of the disease occurring in children above *twelve months* of age, and 'laryngismus stridulus,' I believe, generally attacks children under that age."

827. In reference to the opinion of the croup-like convulsion being dependent upon compression of the *pneumogastric* nerves, I must call my readers' attention to the following observations:—

828. Dr. Merriman observes: "It is by no means an uncommon affection of children, arising generally from *improper feeding*, and close and confined apartments. If timely attended to, the complaint commonly yields to *daily* aperients, so as to produce at least two copious motions, and continued doses of soda, a strong infusion of burnt sponge, with proper attention to diet and regimen. When the head is manifestly affected, cupping-glasses behind the ears are required: but when the patient has *cold, pale, flabby cheeks*, as I have not unfrequently observed in this disease, abstraction of blood is rather injurious than beneficial.

829. "*In two cases* of this kind, which were under my care nearly at the same time, *the children died in fits*. They were both opened by Mr. Sweatman, a very skilful anatomist, but *not the slightest appearance of cerebral affection* could be discovered in either of them. The principal deranged structure discovered, was a collection of small glandular swellings in the neck, pressing upon the par vagum."

830. It has been recently attempted, by Dr. Hugh Ley, to found the pathology of this interesting disease upon observations, such as that adduced by Dr. Merriman; but I think unsuccessfully.

831. This affection has also been referred to enlargement of the thymus gland, by Mr. Hood of Kilmarnock, by Drs. Kopp and Hirsch of Königsberg, by Dr. Montgomery, &c.* and much ingenuity has been displayed in setting forth the rationale of this disease, on the supposition of such an origin. The remarks which I shall make upon Dr. H. Ley's opinion will equally apply to this. And it may be a question, whether the enlargement of the thymus, when observed, be not the *effect* rather than a cause of this singular affection.

832. *In the first place,* as far as my memory and judgment serve me, the cases adduced to support this view, are not cases in point, but, in reality, cases of other diseases.

833. *Secondly,* supposing pressure upon the pneumogastric to exist, it would induce totally different phenomena from those actually observed in this disease: and it would not explain the *series* of phenomena (see § 890) which actually occur in it; for,

834. Such pressure would induce simple *paralysis.* This would, in the first place, affect the recurrent nerves, and the dilator muscles of the larynx; it would induce a *partial* but *constant* closure of that orifice, and a permanent state of dyspnœa, such as occurred in the experiments of Legallois, or such as is observed to be excited in horses affected with "*cornage*" or *roaring,* as described by M. Dupuy in his treatise "De la Fluxion Périodique," 1829, p. 117, &c. It would also induce paralysis of the inferior portion of the pneumogastric, with congestion in the lung or lungs, and the well-known effects upon the stomach of the division of this nerve, with paralysis of the cardia.

835. The disease in question, on the contrary, variously designated, "*peculiar convulsion,*" "spasm of the glottis," &c., is obviously a *part* of a more general spasmodic affection, and frequently, indeed most frequently, comes on in the midst of the first *sleep,* in the most *sudden* manner; receding equally

* See the Medical Gazette for August 1836.

suddenly, to return, perhaps, as before, after various intervals of days, weeks, or even months; very unlike paralysis from *any* cause. Nay, the convulsive efforts in the muscles about the larynx are frequently quite obvious. There is even opisthotonos, or comprosthotonos, in some cases.

836. *Thirdly.* It not unfrequently involves or accompanies, as I have said, *other* affections *indisputably spasmodic*, as distortion of the face, strabismus, contractions of the thumbs to the palms of the hands,—of the wrists, feet, toes, general convulsions, and sudden dissolution,—a series of phenomena totally unallied to paralysis.

837. *Fourthly.* Indeed the larynx is sometimes *absolutely closed*,—an effect which *paralysis* of the recurrent nerve and of the dilator muscles *cannot* produce.

838. *Fifthly.* Paralysis from the pressure of diseased glands would be a far less *curable disease*, a far *less variable* disease, a far *less suddenly fatal* disease than the croup-like convulsion.

839. *Sixthly.* Almost all recent cases are at once relieved by attention to three or four things, viz. the state, 1, of the *teeth;* 2, of the *diet;* 3, of the *bowels;* and 4, by change of *air;* they are as obviously produced or reproduced by the agency of errors in one or more of these.

840. *Seventhly.* In fact, the croup-like convulsion is a *spasmodic* disease, excited by causes situated in the nervous centres, or eccentrically from them; in a case of spina bifida already mentioned, a croupy and convulsive inspiration was induced by gentle pressure on the spinal tumour; in cases from teething the attack has been induced and removed many times by *teething*, and by freely *lancing the teeth*, by crudities, and by emetics, by constipation, and by purgatives, by change of air, &c.

841. *Eighthly.* There is a series of facts which prove the connection of this disease with other forms of convulsions in children, and with epilepsy in the adult subject.

842. *Ninthly.* In protracted cases, congestion and effusion within the head occur as *effects* of this disease.

843. *Lastly.* Innumerable cases of undoubted croup-like convulsion have occurred, in which no enlarged glands could be detected in any part of the course of the pneumogastric nerve.

844. But if the contiguity of enlarged glands with the pneumogastric have any share, in any case, in causing this disease, I believe the action is one totally different from that assigned, and not suspected by the author of this opinion. It is obviously an action upon this nerve, as an *incident excitor* nerve, and not as a mere *motor* or *muscular* nerve.

845. I must here detail an experiment upon the pneumogastric, made by Mr. Broughton, but hitherto unapplied to any question in physiology or pathology. The pneumogastric was laid bare in a donkey, and pinched *continuously* by the forceps; the animal made a sudden act of inspiration and of deglutition. The nerve was divided; the *upper* or *incident* portion of the nerve was pinched with the same effect as before; the *lower* extremity of the nerve was pinched without any effect.

846. I may here, also, refer once more to the interesting experiments by M. Dupuy, p. 130, &c. for a similar fact.

847. In this manner, I conceive, *irritation* of the pneumogastric in the neck *may* have induced the croup-like convulsion. *Irritation* of this nerve might also be propagated to the muscles which close the larynx. *Pressure* upon this nerve, inducing paralysis of its remote extremity, *could not* possibly induce the phenomena in question.

848. It would be difficult to adduce a more convincing proof of the *pathological* and *practical* importance of the views of the nervous system, which I am laying before you.

849. I venture to *suggest* another view of this matter, as nearer the truth, viz. that this disease is induced through the trifacial nerve in *teething*, the *pneumogastric* in indigestion, and *spinal* nerves in constipation, as parts of the excito-motory system. The view itself *points* to the most useful and efficient *remedies*, and this is highly important; it points to the teeth, indigestion, and constipation, as *causes*, and to the well-known means of removing them; it points to the important objects involved in change of air, mental quiet, &c.

850. If, instead of the popular remedy (the warm bath), the *gum-lancet* and full warm-water *enema* were *instantly* administered, many little patients would be saved from the effects of this terrible disease. The diet should be barley-water only.

851. I must repeat the observation that the respiration is actually arrested by closure of the larynx; and that there are forcible expiratory efforts only, or principally, in the actual convulsion. This need scarcely be described; the eyes are distorted from their axes; the face is drawn into horrible forms; the mouth is filled with foam; the body and the limbs are variously and shockingly convulsed. The countenance is livid with venous blood, affording an index to the condition of the brain. There is perfect coma, sometimes long-continued, or there may be sudden dissolution.

852. Sometimes a more transient and partial convulsive movement occurs, like an electric shock. In one deeply interesting case, such a convulsive affection was sometimes ushered in by a sardonic smile. In other moments the little boy was obviously expecting the shock in alarm.

853. In another very interesting case there were strangury and tenesmus, symptoms leading to the suspicion of calculus. The lancing of the gums afforded immediate relief.

854. As, in treating of hydrocephalus, cerebral disease was described as frequently leading to convulsion, so, in those which I have just mentioned, the convulsion frequently leads eventually to cerebral disease, especially congestion and effusion. The due relation of the disease of the cerebral and true spinal subdivisions of the nervous system is plainly seen. Hitherto there has been little but confusion in our views, both of the pathology and treatment of these several diseases.

855. We may now discern that, whilst in the cerebral diseases our remedies were chiefly directed to relieve the morbid condition of the arterial or capillary circulation within the head, in the diseases of the true spinal system our efforts must be made to remove the cause, or causes, of these diseases, whilst we guard against their effects, viz. undue venous congestion of the cerebrum, and effusion.

856. I need scarcely advert to the erroneous views, and, consequently, erroneous mode of treatment, of this affection, of those authors who have considered it as originally an affection of the encephalon. Cause has been mistaken for effect, and effect for cause. The effusion, for example, which is the effect of the previous convulsive struggles, has been consider-

ed as their exciting cause. The whole confusion on this point has arisen from not observing to what subdivision of the nervous system the first symptoms belong. I quite agree with Dr. Merriman in condemning, as useless, or rather as injurious, the indiscriminate and lavish detraction of blood.

857. The proper mode of treatment comprises the remedies—

1. *Against the attacks.*
2. *In the attacks, and in the threatening of the attack.*
3. *Against their effects.*

858. The remedies against the attacks, or the prevention, consists in avoiding all the exciting causes: dental, gastric, intestinal irritation; passion; vexation; disturbance; interrupted sleep, &c.

859. The remedies in the threatening of attacks consist in the watchful and prompt repetition of the same treatment; lancing the gums, relieving the stomach and the bowels. The *sleep* especially should be watched, and if there be a sardonic smile, or starting, or other symptoms, the little patient must be *gently* awakened, and the remedies just enumerated should be administered. Mental agitation must be most cautiously avoided. After the gum-lancet, I would advise a copious enema of warm water.

860. If there be great threatening of an attack, I would tickle the fauces, dash cold water on the face, and irritate the nostrils, having the patient placed, as speedily as may be, in the warm bath.

861. To guard against the effects of the attacks, we may deplete the blood vessels about the head with cupping, or leeches, apply an alcoholic lotion constantly all over the head, or, if the case be urgent, the ice-cap.

862. In addition to these measures, the secretions must be corrected, mild mercurials being given, perhaps, to affect the system; and diuretics, if the urine be scanty; afterwards, change of air is of undoubted efficacy; and a very mild tonic plan may be added with advantage, as minute doses of the sulphate of quinine, of the carbonate of iron, &c. Sponging with *warm* salt and water is also a valuable auxiliary remedy.

863. It is impossible to conceive the vast importance

of this subject. If any thing could add to this importance, it is the fact that the convulsions of infancy frequently lay the foundation of epileptic attacks in youth, or adult age. Sometimes the transition is so gradual and continuous, that the two affections are proved to be obviously the same.

864. With the same objects, the diet and the condition of the bowels must be attended to with *equal* energy. *All* irritation must be avoided; and amongst these, *drastic* medicines must be ranged. A young nurse's or ass's milk should constitute the former. Enemata of warm water may be used, effectually to relieve the bowels, night and morning.

865. The tinctura hyoscyami and the hydrocyanic acid are important auxiliaries; but especially change of air.

866. A cold lotion, the ice-cap, perhaps leeches, must be used to guard the head; the feet must be fomented and kept carefully warm.

867. But I shall here adduce some special remarks on several important remedies; and—

868. 1. *On the Use of the Gum-lancet.*—The subject of *Dentition* has not even yet been fully investigated, in reference to convulsion. I may ask the question—is the *temperature* augmented? This point should be determined by a thermometer. Is there a state of *sub-inflammatory* action? And *may* not this be subdued by scarification of the gums, on the same principle as inflammation of the conjunctiva? Does this view afford us a new and important motive for a more frequent and extensive use of the gum-lancet? May the *excitation* of the trifacial nerve be thus removed, and its *effect* subdued? with these objects, the gums should be fully divided, not once, or occasionally, but *twice*, or even *thrice*, daily. Any thing rather than repeated attacks, which may lead to convulsion, and eventually to cerebral disease, enfeebled intellect, or crippled limbs.

869. That the condition termed *teething* is a source of *morbid reflex action*, is, I believe, generally admitted. By this term I do not understand the mere act of piercing through the gums by the teeth; but the general process of dentition,—of the formation, ascent, and growth of the teeth. This process resembles the similar process in the growth of the horn in the deer, and is equally attended by augmented vascular action and augmented temperature, and may, in some measure, be

compared with the action in inflammation. In a medical point of view, we have sufficient inducement to relieve the over-acting vessels; and I would propose to scarify the gums, on the same principle as that which leads us to scarify the inflamed tonsils:—We divide the vessels; we induce the flow of blood; we diminish the undue action; we relieve the irritated nervous tissues, and the effects of that irritation subside. The idea of merely dividing the gum to allow the teeth to penetrate it, is inadequate to the real importance of this all-important remedy.

870. In order to accomplish all that this measure is capable of effecting, we should lance the gums *freely* and *deeply*, over a great part of their extent, *daily*, or *even twice a day*, and apply a sponge with warm water, so as to encourage the flow of blood.

871. The principal part to be lanced is the more prominent portion of the gum; but, in some urgent instances, I have recommended the *lateral* portions also to be freely scarified. The object, which is that of effectually relieving the vascular tissue and action, and so diminishing the tumefaction, and the pressure on the nervous tissue, *must* be accomplished.

872. 2. *Irritation of the Fauces.*—Next to free scarification of the gums, I must mention the irritation of the fauces, after giving diluents, so as to induce vomiting, in cases of crowing inspiration. Instant relief frequently follows free scarification of the gums. To excite vomiting by irritation of the fauces, as instantly relieves the stomach from any crudities which may be the exciting cause of this singular but sad affection.

873. 3. *The Use of Lavements.*—Then should follow the free use of *lavements*. The intestine should be cleared by this remedy; warm soft water should be injected very slowly, until the intestine, after being *filled*, begins to be *distended;* it will then contract forcibly, and, with the mass of water, will expel its solid, perhaps scybalous or otherwise morbid, contents.

874. 4. *Aperient Medicines.*—The enemata must aid, and be aided by, some mild aperient, as the *simple* decoction of aloes. But I am confident that *drastic* purgative medicines

do harm, and prove a source of irritation in themselves, and keep up the disposition to spasm. Aperients should be administered so as to remove, and not to become, sources of irritation.

875. With this last view, it is well to add the hyoscyamus to the aperient.

876. Irritation of incident nerves is, in a word, the most frequent cause of this disease, and must be removed if it exist, and avoided in every thing we do. The diet, and the medicine administered, should therefore be of the mildest kinds.

877. I cannot conscientiously omit the expression of my conviction that the bloodletting system, and the calomel system, of treatment, recently in vogue in this complaint, under the sanction of the highest authority, and under the impression that the affection was of *cerebral origin*, have been extremely injurious in their consequences.

878. I have seen only one case in which the plan which I have here proposed has proved unsuccessful, when employed in the *dawn* of the disease; and that case was attended by induration of the medulla oblongata, and tetanic symptoms; it was, in a word, of centric origin. But I have seen innumerable cases in which bloodletting and calomel had not prevented the recurrence of convulsions, and the consequent effusion into the ventricles of the brain.

879. I may observe, that this is one of the cases in which the morbid anatomy has *misled* us. Important as the *pathological anatomy* is, there is a *living pathology*, more important still.

880. 5. *Change of Air.*—In the crowing inspiration, as in pertussis, the baneful effect of the north-east winds, and the beneficial effect of a change, are most remarkable.

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881. Within the short space of one month I have seen five cases of *croup-like convulsion*. *All* have yielded to the remedies which I have described as being of such value in this disease, if only timely administered.

882. Three of these cases were of short duration. Strabismus, with *dysury*, in one, contracted fingers in another, forboded the crowing inspiration. Both yielded to free and

repeated scarification of the gums, and a strictly regulated diet, and state of the bowels.

883. In the *fourth* case it was feared that effusion had taken place into the ventricles. There were strabismus, a retracted head, a state almost of opisthotonos, contracted fingers and toes, attacks of fright, suspended respiration, obvious spasm of the muscles about the throat, and crowing. These fearful symptoms ceased on using the most free and repeated scarification of the gums, a diet of ass's milk, and a free state of the bowels, with the tinctura hyoscyami.

885. In the *fifth* case there was obvious danger of asphyxia, contracted pupils during the paroxysms, and dilated pupils afterwards, and a state of emprosthotonos. A change of air suddenly removed the disease, which seem to linger during the use of the other remedies. The case arose, apparently, from a state of torpor or constipation of the bowels.

886. But I have recently witnessed a case, in conjunction with Mr. Chisholm of Devonshire Street, of a most interesting kind. It was characterized by most *extensive, tense anasarca.* I am indebted to Mr. Chisholm for the following account of it:

Case of Crowing, with tense Anasarca.

887. " W. R. aged ten months, a stout, plethoric, healthy-looking child, was suddenly seized, on Sunday evening, the 6th of December, 1840, with screaming, pain and tenderness low down in the abdomen; inability to pass water; insteps and ankles much swollen; swellings white, glistening, and pitting; face flushed; sneezing, and suffusion of the eyes; breathing anxious and hurried, with a peculiar crowing sound, something like a whoop, accompanying each inspiration. I examined the gums, which were tense and hot, tender to the touch, and very tumid, and covered with white-looking, membranous shreds; tongue brown and furred; breath offensive; bowels very constipated. I lanced the gums freely up and down; administered an injection, and the warm mustard bath, and purged.

888. " I continued in attendance for ten days, lancing and purging only; but this treatment I put into practice unsparingly. My little patient having been sent away to be weaned, I

heard nothing more for about a fortnight, when I was hastily summoned. I found the child just recovering from an apparently severe spasmodic attack. All the symptoms much the same as when I was first called in; little or no urine passed; tongue dry and brown, and thickly furred; breathing hurried, hot, and offensive; bowels costive; general fever; hot, flushed skin; pulse quick, small; sneezing; suffusion of the eyes; flushed countenance, with nausea or sickness; gums hot, tender, and tense; feet anasarcous as before; fingers stiff, and drawn inwards; each thumb much inverted into its respective hand; frequent crowing convulsions. This order of symptoms went on increasing in severity for about a week, notwithstanding, as I imagined, an active treatment, each inspiration being accompanied by a peculiar crowing, whooping noise or sound, immediately preceding each paroxysm of convulsions. I then considered it advisable to call in the aid of my kind and able friend Dr. Marshall Hall, to whom I owe a great debt of gratitude for the prompt and able manner with which he urged a perseverance of the means I had already employed, under which the child gradually but slowly recovered." (March 4th, 1841.)

889. I conclude by once more calling my readers' attention to *Plate* VI, *fig.* 2. It *depicts* the closed larynx, with *croup-like convulsion.* It presents to the *eye,* for the first time, the anatomical relations of the *causes,* and their immediate *effects,* in this interesting disease. The *arrows* denote and distinguish the incident, excitor nerves, through which those causes act; and the reflex motor nerves, through which the final effects are induced upon the muscular system. It must be *studied,* for it affords much subject for reflection. It will be observed that the pneumogastric is continued on the right hand, to the *liver* and the *kidney.*

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890. In conclusion, I may observe, that the only just mode of viewing this interesting malady is, to consider the *series* of phenomena observed in it, comparatively with some other diseases:

891. This series consists—1, of *contracted hands and feet;* 2, of *strabismus;* 3, of *grinding of the teeth* during sleep; 4, of *diminished* secretion and flow of the *bile,* and, 5, of the

urine, with, 6, *tumidity of the hand and instep;* 7, of *strangury;* 8, of *tenesmus;* 9, of *partial closure of the larynx*, with *crowing inspiration;* 10, of *complete closure* of the *larynx*, and threatened *asphyxia;* 11, of obvious convulsive movements of the muscles of the *external part of the throat;* and 12, of *general convulsion.*

892. There is only *one* mode of explaining *all* those events, *and* the very *similar* events from similar causes (as I deem them) in *epilepsy.*

893. Amongst other symptoms are frequently observed *bileless fæces* and *morbid deposits* in the *urine.* That the excitor nerves may transfer their influence in dentition, in gastric crudities, in constipation, to the true spinal marrow, and thence to the branches of the pneumogastric nerve, may be regarded as proved. Now this nerve sends a branch precisely to the *liver* and to the *kidneys.* Through the medium of these branches, the secretion, or the *excretion*, of the bile and urine may be impeded; and the events confirm the theory.

894. The *effects* are seen at the extremities of the *reflex* nerves; the *causes* and the *remedies* act upon the commencements of the *incident* nerves. The true spinal marrow is the *key-stone* between these two arches.

895. In other instances, the pneumogastric is an incident nerve (for it is indubitably a *compound* nerve), and thus it is the *excitor* in vomiting from emetics swallowed, and in cases of hepatic and renal calculus.

896. The sudden death which occurs in the croup-like convulsion is, most probably, of the nature of asphyxia, or of secondary asphyxia. Such an event occurs, though rarely, in epilepsy, when the attacks are repeated with short intervals; and in tetanus; but still more in hydrophobia. The defectively arterialized blood probably poisons or paralyses the heart in the coronary arteries, or the medulla oblongata in the vertebrals.

897. The blood, which, in the coma of epilepsy, induces stupor by paralysing the brain, also induces stertor by paralysing the medulla oblongata.

898. This subject is another added to those already noticed as requiring fresh investigation.

V. *The Nature and Treatment of Choking.*

899. Choking is only another form of the croup-like convulsion, arising from a more sudden but less permanent *cause*, acting upon *other* incident excitor *nerves;* and it is to be treated upon precisely similar principles. *The cause must be effectually removed, and as speedily as possible.* I may refer my reader to § 358: but I wish to revert to the subject in this place.

900. I was witness to the case of choking the other day: respiration was arrested; there was a fearful struggle for breath! Not a moment was to be lost: I took the boy and placed him between my knees, so that I could make free pressure on the abdomen, whilst I placed one open hand on the posterior part of the thorax, and struck with the flat part of the other, gently closed, on the anterior,—briskly, forcibly: the latter part of this operation was promptly performed; and the little patient was instantly relieved.

901. The other day, the mother of a most intelligent lady, whose husband is liable to epilepsy, was suddenly choked: the phenomena were precisely those which precede or commence the epileptic attack! This remark was made by the lady in question, who was but too well acquainted with the terrible appearances in that morbid affection.

902. I must here adduce a case from the Dublin Hospital Reports, vol. ii, p. 224, described by Mr. Kirby:

903. "One evening in November 1815, I was called to visit a poor woman who was brought to St. Peter's and St. Bridget's Hospital by some humane persons, who found her in the street in an almost lifeless condition. She was one of those miserable creatures, who feed in our streets upon the mixed offal which they receive from servants. She was greedily enjoying this wretched fare, when a morsel stuck in the œsophagus. When I arrived at the hospital, she was dead to all appearance, yet I opened the trachea above the sternum, and patiently inflated the lungs for a considerable length of time, but to no purpose. At the sides of the neck there prevailed a remarkable fulness, which I could not explain until the parts were afterwards examined.

904. "On the day following, a coroner's inquest was con-

vened, and the neccessary dissection was performed by Mr. Michael Daniel. Three large morsels of food were found in the œsophagus: the superior, which seemed the largest, lay immediately behind the cricoid cartilage; the inferior occupied the œsophagus nearly as low down as the upper extremity of the sternum. This morsel contained a piece of bone an inch and a half long, one of its ends being very sharp and pointed. The bone lay obliquely across, transfixing the œsophagus at its left and posterior part, and wounding the right subclavian artery, which, contrary to its usual course and origin, lay in this situation as it passed from the left of the arch of the aorta, where it arose, towards the right shoulder. The surrounding cellular membrane was filled with blood, which accumulating principally at the sides of the neck, had produced the fulness of the surface, a circumstance until now inexplicable. The œsophagus and trachea were both free from blood. The latter was pervious, and did not seem diminished by the pressure of the morsels. The epiglottis almost completely concealed the cavity of the glottis, which was so diminished by the forward inclination of the arytænoid cartilages, as to be scarcely discernible. The rima glottidis was altogether closed.

905. "I have annexed a drawing of this very interesting dissection, taken from the preparation, which is preserved in my Museum in Peter Street."

906. "This case adds to the list of those which attract us rather by their singularity than by the usefulness of any hints they furnish to the practical surgeon. It seems, however, to confirm the opinion, that it is not to the mechanical obstructions of the trachea we are to look for the immediate cause of death, when a solid substance is arrested in its descent through the upper part of the œsophagus, so much as to the spasmodic constriction of the muscles of the glottis, which are suddenly and powerfully excited by the presence of the obstructing body.

907. "Neither the wound of the artery, nor the consequent effusion of blood, appears to have contributed to the suffocation."

908. I do not agree with Mr. Kirby in his statement that this case does not suggest any hints to the practical surgeon. On the other hand, it is plain, that not the probang, which

may not be obtained in due time, nor any attempt to reach the object by the finger, can be successful in this urgent case; the excitors of vomiting must be called into action, so that the cardia may open, and either vomiting, or the sort of artificial vomiting, which I have described as resulting from a firm blow on the thorax, may be induced.

909. If this plan fail, the *probang* should be used; and, if necessary, *tracheotomy* should be performed.

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910. Nearly allied to the crowing inspiration is *hooping cough*. The difference appears to be, that there is much less disposition to actual *closure* of the larynx in the latter than in the former. But there is a similar disposition to convulsion, and consequent effusion into the brain, though less in degree, and the state of asphyxia and of defective arterialization of the blood is the same. Change of air produces similar extraordinary effects in both. The cough,—convulsions even,—may cease from that moment.

911. Not dissimilar is *Asthma*. The croup-like disease, hooping cough, and asthma, appear to be modified—1, by the *part* of the air-tubes principally affected; and 2, by the *age* of the patient.

VI. *Stammering; Chorea.*

913. In *stammering*, the act of volition is rendered imperfect by an action independent and subversive of the will, and of true spinal origin. In some instances, an act of *inspiration* is excited at the same time, which is equally involuntary; but, in general, there is a violent effort of expiration, and, in the worst cases, the disease is of an almost convulsive, not to say epileptic, character!

914. Stammering, as a disease, is sometimes induced by a morbid condition of the intestines, acting through the incident nerves. Dr. Bostock has recorded such a case in the Medico-Chirurgical Transactions, vol. xvi, p. 72; it was cured by purgative medicines.

915. In all cases this affection is aggravated by indisposition, and by emotion or agitation. It is best remedied, when not hereditary or inveterate, by attention to the general health, and especially by purgative and tonic medicines, and

by acquiring a habit of self-possession, and of speaking in a subdued, continuous tone, first dilating the thorax.

916. I had one interesting case in which *attacks* came on, from time, to time of a peculiar loss of speech. On attempting articulation, the patient drew an inspiration, making a hissing noise between the lips, and suffering acute pain around the false ribs, about the insertions of the diaphragm.

917. Stammering is very like a very partial chorea; it is not, I think, as Dr. Arnott supposes, an affection of the glottis, or larynx, that is, of the organ of the *voice*, but of some of the different parts which constitute the machinery of *articulation*. For a disquisition on this point, I refer my readers to the Journal of the Royal Institution for February 1831. I have there given my reasons for adopting a different view from that of Dr. Arnott, and have explained the various forms of stammering on the principles of the physiology of the articulation of the different orders of letters. I shall adduce, in this place, as much of that paper as may have a practical bearing on this subject:

918. [It is from their influence on the respiration that I formed the division and arrangement of the consonants, published in the nineteenth volume of this Journal; their subdivision was founded on the respective mode or mechanism of their enunciation. I divided them—

919. 1. Into those in the enunciation of which the posterior nares are closed, and the respiration, of course, completely arrested:

920. 2. Into those in the enunciation of which the nostrils are closed, but the mouth left more or less open, for the exit of the air, which is compressed, but not interrupted in its expiration:

921. 3. Into those not requiring even the nostrils to be closed, and in the enunciation of which the air is still less compressed in its course from the lungs: and,

922. 4. Into those in the articulation of which the expired air is not interrupted, and scarcely impeded at all.

923. Of the *first* class, are

B ; D ; G*
P ; T ; K.

* i. e. the *hard* G

924. In tracing these letters into their sub-divisions, we may observe, that the first pair are labials, being formed by the lips compressed together; the second pair are linguo-dentals, being formed by pressing the point of the tongue against the posterior and upper part of the upper teeth; and the third pair are linguo-palatal, being effected by pressing the middle part of the tongue against the palate. In all, the posterior apertures of the nostrils are effectually closed by the pendulous vail of the palate being drawn upwards, and accurately applied to their posterior apertures. And, of course, those persons whose palate is perforated, or in whom the pendulous vail of the palate is imperfect, as sometimes arises from disease, are more or less incapacitated from pronouncing these letters, the expired air being no longer intercepted, as it ought to be, in its course.

925. Of the *second* class, are

$$\begin{matrix} \mathrm{F} \\ \mathrm{V} \end{matrix}\text{; the TH, hard and soft; and } \begin{matrix} \mathrm{S} \\ \mathrm{Z} \end{matrix}.$$

926. In the articulation of these letters, the posterior orifices of the nostrils are required to be closed, whilst, in the first pair, the compressed air is continually forced between the upper teeth and under lip; in the second, between the teeth and the tongue; and in the third, between the point of the tongue and the anterior part of the palate.

927. From this view of the subject, it will be readily apprehended how the substitution of D or T for the TH, by foreigners, is so remarkable; for it is no less than the substitution of a total interruption, for a mere compression of the air, in its exit from the chest.

928. Of the *third* class of letters, are

M; N; L; R.

929. In the enunciation of these letters, the expired air is only very slightly compressed, the nostrils being left freely open. It is for this very reason, probably, that these letters have been termed *liquids*, as flowing without obstacle. And it is by this circumstance, principally, extraordinary as it may appear, that the letter M differs from the letters B and P, for they are all equally labial; and that the letter N differs from T and D, for they are all equally formed by placing the point of the tongue near the roots of the upper teeth.

930. Of the *fourth* and last class, are

H; the Greek X; Y; and W.

931. In the enunciation of these consonants, the air appears to be scarcely compressed or impeded in its exit at all. This fact may, I think, account for the circumstance, that it has even been doubted, whether the two last letters be really consonants or not; and for the remarkable fact, that they cannot, as *consonants,* form the termination of any word. Their mechanism is guttural, double dental, and labial, respectively.

932. These letters, preceded as they are in this arrangement by the liquids, lead us almost insensibly to the class of letters to be next noticed, namely, the *vowels.*

933. These are so called, from having been supposed to relate to the *voice* alone*. This, however, is obviously an error. The different parts forming the mouth, or organ of *speech,* are not less necessary to the enunciation of the vowels, than to that of the consonants, or their function less appreciable, on carefully making the experiment. Thus, the French U is entirely labial; the letter E is dental; O, palatal; whilst the dipthong AW, and the vowels marked in the French language by the circumflex (ʌ), are guttural.

934. Now let any one carefully examine the effort made by the stammerer in his attempts at the enunciation of these various letters. It will be obvious that the malady is but an exaggeration of the natural effort. In attempting to pronounce the letters of the first class, violent efforts are made, yet expiration—articulation—is not effected; but there is frequently, nay, generally, a peculiar noise heard in the larynx, although its full enunciation is prevented by the action of the muscles of the mouth. But if the letters of the second class are pronounced with stammering, there is perpetual hissing from the escape of compressed air, in the case of the letters F and V, between the lips; in that of the TH, between the tongue and upper teeth, and in that of the letters S and Z between the teeth. In the stammering enunciation of the letters of the third class, there is frequently a state of laborious respiration. In all these cases, then, it is plain that the

* Blumenbachii Institutiones Physiologiæ, ed. 1810, sectio ix.

larynx is open ; any considerable effort applied to the parts concerned in the articulation of the first class of letters,—the least noise,—the least escape of air, alike demonstrate this fact. In the natural, and in the stammering articulation, there is the same total or partial interruption of the expiration, at the same parts, not of the larynx, but of the proper organs of articulation, only in different degrees. Let the larynx be really closed, which may be done after a little trial, and it will immediately be discovered that stammering is, in fact, impossible ; the effort made by the force of the expired air against the parts of the mouth called into action in the articulation of the first class of letters,—all escape of air,—all noise, become totally interrupted.

935. I have just attentively watched the attempts of a stammerer to articulate the various letters.

936. In the effort to pronounce the first class of letters, especially the letter T, still more if two T's come together, as in the words THAT TREE, the face became flushed even, from interrupted expiration ; yet there was, at every repetition of the effort, a noise audible in the larynx, proving that this part was unclosed.

937. In pronouncing the letters of the second class, a repeated hissing noise was distinctly produced by the flow of the compressed air, in one case (F, V), between the under lip and upper teeth ; in the second (TH), between the tongue and upper teeth ; and in the third (S, Z), between the teeth.

938. In attempting the articulation of some of the letters of the third and fourth classes, and some of the vowels, the breath was sometimes lost, as it were, in a full and exhausting expiration, altogether peculiar.]

939. If the recent observations of Mr. Yearsley prove correct—that stammering is to be cured by excision of the uvula or tonsils,—a new ray of light will be thrown on this singular malady. Is the uvula the excitor-regulator of articulation? Is it, in cases of stammering, unduly excitable?

940. *Every* voluntary act *combines* with itself an excito-motory action. The contact of an object with the palm of the hand, the sole of the foot, induces an additional muscular contraction beyond that of the original stimulus of volition. Articulation may be regulated in the same manner. A

reflex arc between the uvula and the organs of articulation would not be more marvellous than many others. How extraordinary, for example, is the act of vomiting induced by irritation of the fauces! How singular, that substances passing the fauces in deglutition do not produce the same effect! How do the incident excitor nerves of vomiting escape?

941. I may further ask, what is the state and position of the uvula in articulation? The velum and, with it, the uvula are elevated and placed so as to close the posterior nares, whenever certain letters are pronounced. Are incident nerves, regulators of articulation, excited in this case? And are they unduly excited in stammering? And is stammering not only an undue *spinal* action (as I stated many years ago), but an undue *reflex* spinal action? These interesting questions, time and long investigation alone can determine.

942. Further, can the uvula and adjacent parts be implicated in chorea, the subject next to be briefly noticed? or in epilepsy itself! These and other questions crowd upon the mind in reflecting on this subject.

943. *Chorea* is distinctly an affection of the true spinal system; it affords an example of the want of harmony betweeen the cerebral and the true spinal acts; *volition* is normal; the true spinal action is abnormal. The *action* is abnormal, or irregular, for want of a precise harmony between the two.

944. It is by acts of volition that the acts of the true spinal system are called into play: it is, therefore, when volition is excited, that the chorea is most distinctly manifested. The articulation and all the voluntary movements are irregular and impaired: the same thing is observed on any emotion. During sleep and repose, on the contrary, the chorea is mitigated, or disappears altogether, especially in the early stage.

945. That chorea is excited through a morbid state of the bowels, there can be no doubt: it ceases frequently on removing this disorder. It involves, however, a morbid condition of the true spinal system, which certain tonics, and especially the arsenicum and the carbonas ferri, remove. It is, however, in the beginning, not a centric, but a centripetal disease.

946. Chorea frequently assumes a hemiplegic character;

that is, it affects one side more than the other: it also passes on from irregular motions to a sort of paralytic weakness; and eventually the mind, as well as the limbs, becomes enfeebled. Like some other true spinal diseases, centripetal in their origin, chorea becomes centric and cerebral in its course before its fatal issue. I shall revert to this subject.

VII. *Amentia; Paralysis; Spasm.*

947. I have seen, in many cases, a state of amentia, and of paralysis, or of spasm, the consequence of attacks of hydrocephalus or hydrocephaloid disease, and of convulsions. A fatal issue of these diseases is most desirable, in comparison with these sad results. Similar events probably originate *in utero*, from a similar state of disease of the nervous centres.

948. In regard to *amentia*, it is a question how such a patient should be *educated*. I am persuaded that the maxim, nulla dies sine lineâ, is the proper one for these deplorable cases, whilst any effort or strain of the feeble intellect should be avoided.

949. The case of *paralysis* which usually assumes the hemiplegic form, is, I think, benefited by a similar plan of mild exertion; and, perhaps, by the sustained use of galvanism. Dr. Abercrombie observes—

950. "It is now upwards of twenty years since I first saw a girl, aged, at that time, about eighteen months, and previously enjoying excellent health. She had been left for some time sitting on the damp grass, and was immediately seized with fever, accompanied by such a degree of oppression as led to an apprehension of an affection of the brain. These symptoms, however, passed off in a few days, and, upon her recovery from them, it was found that she was entirely paralytic in the right lower extremity. She has from that time enjoyed uninterrupted health, and is now a tall and strong young woman; but the right lower extremity has continued entirely paralytic; it is also a great deal smaller than the opposite extremity, and several inches shorter. All the joints are remarkably relaxed, and the muscles flaccid; but there is no other appearance of disease in any part of it, or in the spine."

951. We frequently observe a *hemiplegic* paralysis from defective development of the opposite hemisphere of the cerebrum. In this case, *both arm* and *leg*, but chiefly the arm, are involved in the paralysis. But it occasionally happens that *one leg only* is affected with a *partial* paralysis; the limb does not *grow* as the other leg does, but remains thinner and shorter; yet it does grow, so that the paralysis is not complete, and it is moved only with somewhat less power than the other leg. What is the nature of this partial paralysis? Is it of dental origin? Is it an affection of the spinal marrow, or of its nerves, equally partial? Cases, and careful examinations, are entirely wanting to determine these questions. I think this subject might be illustrated by the experiment of dividing the posterior or *ganglionic* nerves of the spine which proceed to the lower extremity, in a very young animal. Sensation with *nutrition* would be lost, or impaired, whilst the muscular power would remain.

952. The case of *spasm*, which induces the various forms of club-foot, &c. has recently been relieved by dividing the tendons of the muscles affected.

953. I am indebted for the following interesting case to my friend Dr. Webster:—"When my boy was about twenty months old (he is now nine years), he had a fit of illness, connected with dentition, which threatened the brain, and for which I opened the jugular vein, and purged him. This took him off his feet, and, very soon after, he had a fall from a rather high crib bed; but this was not attended or followed by any apparent bad consequences. The child recovered his health; but for some weeks he seemed to have almost entirely lost the use of his legs; and, being uneasy about him, several of my medical friends saw him; among others, I think, yourself. He gradually, however, began to walk again; but not so steadily as before, as he tottered much in his steps, and was constantly falling over every little object that happened to be in his way, and he had much less command over the left limb than the right. He seemed to walk on his toes. It was not at first ascertained that one leg was more affected than the other; but as he grew up and was breeched, the matter became more apparent: he plainly walked more firmly on the healthy limb, and less so on the

lame one, and he threw it about more in walking and playing, and rarely set down the heel, except when walking slowly; never when running. He now runs on the toes of that foot, and with a sort of lurch; the limb is less firm; the muscular power is evidently less, but the sensibility seems equal to the other. I have only to add, that the affected limb is about an inch shorter than the other, which is the reason of his walking on the toes."

954. This case has been much relieved by the division of the tendo Achilles.

955. I conclude this subject, so briefly sketched, by pointing it out as presenting another interesting field of investigation.

VIII. *Paralysis from Dentition.*

956. The next form of paralysis which I shall notice, arises from *dental irritation.*

957. A little girl, aged twenty months, was taken, when suffering from dentition, with loss of the power of elevating the right arm—that of closing the hand remaining; there was no *other* symptom of cerebral affection. The suffering from dentition was undoubted; I therefore concluded that the case was one of paralysis from teething.

958. The gums were freely lanced, the bowels were well moved, the diet strictly regulated; and, for *fear* of hidden disease within the head, two leeches were applied. An embrocation was prescribed for the arm.

959. A few days after the attack of paralysis, this little girl was seized, in the early part of the night, with a fit of crowing inspiration. This event confirmed *me* in my diagnosis. The issue justified the view I had taken. The child recovered *perfectly*, without any energetic remedy being used for cerebral affection, by continued attention to the state of the gums, the stomach, and the bowels; an event which could scarcely have occurred from such simple measures, had there been such decided affections arising from cerebral disease.

960. This case was watched with peculiar interest, from the circumstance of its occurring in the family of a medical friend, Dr. Grant, of Thayer Street.

961. But I will give this interesting case in Dr. Grant's own words:

962. "M. A. G——, at twenty months, has been suffering for some time from dentition, being fretful, and having a cough during the night. This morning, April 30, 1835, her mother observed that she was incapable of raising the right arm; she retained the power of swinging the arm backwards and forwards, and bending the fore-arm on the arm, but had not the least power to raise the arm itself, as if the deltoid muscle only was paralysed. On examining the arm, the child suffers no pain, and there is not the least reason to believe that any accident could have occasioned this loss of power. The general health of the child, with the exception above mentioned, is excellent; appetite good; bowels are every day relieved.

963. "Dr. Marshall Hall, on seeing the child, recommended a gentle emetic, followed by a dose of castor oil; the gums, over the four eye-teeth, which are all coming forwards, to be carefully lanced every second day; and, alternately, an embrocation to the arm, and a light unirritating diet.

964. "May 7th. Little alteration in the state of the arm, which the child is perfectly unable to raise in the smallest degree. The castor-oil is given every morning, which produces free and healthy evacuations; the gums have been repeatedly lanced, but the teeth do not advance: she still coughs during the night, but last night she had several fits of coughing, resembling the convulsive crowing of croup; but, as there was no heat of surface, or quickening of the pulse, nothing was done. To-day it was considered prudent to apply two leeches to the back of the ear, and have the hair removed from the back part of the head, and the same plan of treatment as before was pursued.

965. "14th. There has been no return of the crowing cough, and the child's general health continues very good. She now evidently has regained some power in raising the arm. Continue the mild diet; occasional doses of the oleum ricini, lancing the gums, and the embrocation to the arm.

966. "21st. She daily acquires more the use of her arm. One of the teeth has come up to the surface, and the others are advancing.

967. " June 10th. She has nearly regained the complete power of her arm; her night cough is almost gone, and general health improving. The other teeth are not quite through yet. Regularity of diet and attention to the bowels enjoined.

968. " August 20th. The child has been for some time in the country, and has perfectly recovered the use of her arm. The four teeth are quite through. Up to the present time she has never changed her diet in any way, taking bread and milk for breakfast and supper, and bread pudding, with a single egg in it, for dinner. Her bowels are so regular that she has required no medicine for some time.—August 20th, 1835."

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969. It will be admitted that the subjects discussed in this chapter present scope for much new inquiry. A series of *cases* must be taken with the utmost care, and including every detail: the secretions must be examined, especially that of the urine; and the state of the cerebral and true spinal symptoms must be carefully detailed. I have known, for example, the habit of sleeping in the day to be broken as the first symptom of affection of the nervous system: I have already noticed the early occurrence of vomiting; and I have several times alluded to the diminished secretion of urine. The influence of the passions; of sleep, and of the act of awaking; of situation, of the air; of teething; of crudities; of constipation; of ascarides; and especially of rough purgatives, &c. &c. must be carefully traced.

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970. In reference to convulsive affections, I ought to have observed that, as there is no symptom which may not alone constitute the attack, so there is none which may not be entirely absent.

CHAPTER VI.

PATHOLOGY OF THE NERVOUS SYSTEM IN ADULT AGE.

971. From infantile to adult age the *cerebral* system undergoes a gradual and progressive development; many of the phenomena of the *true spinal* system are, consequently, *obscured*. But, I repeat, these latter are only obscured; they are not enfeebled or diminished. In the close of life, the true spinal functions are as energetic and as essential as in its dawn. I have already pointed out the mistake of M. Lallemand in reference to this point: § 634.

972. The functions of the cerebral system—sensation, perception, judgment, volition, voluntary motion, § 302, are gradually developed from infancy to adult age. It is the ψυκη, the animus, the soul, enthroned on an organisation which becomes gradually more and more perfect. These functions are *psychical*. How different from those of the true spinal or mere excito-motory system. By the former we *feel* external impressions, *perceive* external objects, *judge* of their properties, *wish* and *will* to approach and avoid them, and actually *move*, by a *voluntary* effort, to or from them. By the latter, when an external object induces an appropriate action in certain muscles, its ingestion into the animal frame is effected or prevented, without any cognisance of our mind or will, although sometimes with such concurrence shown by additional voluntary acts. Thus, the atmospheric air is inspired, while carbonic acid is excluded, without any voluntary, cerebral, or psychical act; the sphincters still act, when the organ through which the soul manifests its faculties is removed. How extraordinary that these distinctions have never been clearly demonstrated before.

973. The cerebral functions have an influence over those of the spinal marrow; some of these, as respiration, have, therefore, received the designation of *mixed* functions. The

true view of this matter is that which I have just given. They are excito-motory. But volition has an influence over them. The passions, also, have a certain influence over the excito-motory and the ganglionic systems.

974. During *sleep* the cerebral functions are in a state of repose, but the true spinal functions continue in activity and energy. In *coma*, the true spinal functions become eventually more or less impaired.

975. The spinal functions appear to be entirely of a *vital* kind, as distinguished from what is psychical or sensorial. They are excited by appropriate stimuli, and preside over the acts of ingestion and egestion. Nothing can be more marked than the distinction between them and the faculties of the soul, to which I have just alluded.

976. I do not wish to press the metaphysical argument beyond its legitimate application; I may, however, add, that this is the only view of the subject according to which the *individuality* of the sentient being can be maintained. Does *one* sentient being, when divided, become *two?*

977. Leaving this argument out of the question, the view which I take of the subject is the only one which enables us to remove the difficulty experienced by Legallois already noticed: § 160.

978. If another argument were wanting upon this subject, it would be that afforded by the case of M. Brachet, already quoted, § 333, and other cases of a similar kind, in which sensation *was* actually annihilated, and yet the true spinal excito-motory functions *did* continue. It is preposterous to say there *is* sensation in such cases. The sphincters, &c. act, therefore, upon another principle.

979. In *every* determinate motion of an extremity, *two* principles of movement are called in action:—1, Volition; 2, the excito-motory power. One of them may be deranged, diminished, annihilated, without the other.

980. If I grasp a cane, volition begins, the excito-motory power completes, invigorates, the act. I have particularly noticed the fact of a patient, partially paralytic of the arm and hand, being able to close his hand upon a cane, although he was unable to do so without that excitant.

981. Dr. Little gives the case of a patient who had the

perfect movements of the lower extremities, but, on placing one of his feet upon the ground, an excito-motory contraction of the gastrocnemius was produced, and his heel was raised involuntarily.

982. Suction in the anencephalous fœtus is purely excito-motory; so is the action of the hand on placing an object in the palm; and it is this property which maintains the bird upon its wing, in its protracted flight, and the fish in the midst of the stream.

983. Provision is made for these phenomena in the *anatomy*. The medulla oblongata is expanded on account of the many organs placed under its excito-motory influence. The enlargements of the medulla spinalis at the origin of the *brachial* and *crural* nerves, in some animals, are doubtless destined for the same objects, and are more or less proportionate to the *quantity* of function, if I may use that term, in different species. These enlargements are so many noduses, as it were, of the true spinal system.

984. The force of muscular action in animals is more in proportion to the violence of their *passions*, than of their *volition*. Now, the passions act through the excito-motory system; this system is therefore proportionately developed. The carnivora have, consequently, a higher degree of ferocity, of muscular energy, and, probably, of true spinal development, than the herbivora.

985. In disease, we have augmented or impaired volition, as in mania and in typhus; or of the excito-motory power, as in the effects of strychnine and of the hydrocyanic acid. What a vast field is open for cultivation!

986. In many diseases the influence of the excito-motory power, and of the passions, over acts of volition, is most obvious, as is also that of volition over the excito-motory power. Let the patient in chorea be directed to move his hand in a given manner; we shall immediately observe the distorted movements produced by the disordered agency of the excito-motory power. Let the patient be agitated, his chorea is tenfold worse than before. The disordered actions of the chorea are also aggravated by every act of the will; they subside, on the contrary, during sleep. I have this day seen a most distressing case of torticollis; when the patient

is reposing, or asleep, the spasmodic action is greatly diminished; but, on every voluntary act, or motion of the body, and on any occasion of emotion, the spasm is augmented exceedingly.

987. In certain cases, both sleep and passion seem alike to induce attacks of diseases of the excito-motory system,—as of the croup-like convulsion in children, and of epilepsy in adults.

988. I must now observe that the phenomena of the excito-motory system, like irritability, remain longer after decapitation, in very young animals, than in animals of adult age. This fact results from Legallois' observations.

989. I need not repeat that this able physiologist confounded the excito-motory function with sensibility. But, by interpreting his expression "of sensibility and voluntary motion," by that of excito-motory phenomena, his *facts* still remain, and are of great interest and importance.

990. Before I proceed any further with my account of the nervous system and its diseases in adult age, I will present a sketch of the arrangement of these diseases. I must first divide them, as I have done the nervous system itself, into

I. *The Cerebral, or Sentient and Voluntary;*

II. *The True Spinal, or the Excito-motory;* and

III. *The Ganglionic, the Nutrient, the Secretory, &c.*

991. In our subdivisions of these diseases we must still be guided by those of the nervous system, given at length in a preceding page, to which I must beg to recall the particular attention of my readers.

992. I must also recall their attention to a remark which I made in a preceding paragraph, in reference to a division of the diseases of the *true spinal* system into the *centric* and the *eccentric*. To these last, a recent statement of M. Andral is extremely applicable.—"Que le nombre d'altérations connues est petit à côté de celui des lésions qu'on ignore! Les cas où, après la mort, on trouve quelque chose d'appréciable pour le scalpel sont les plus communs pour les autres organes; pour le système nerveux, c'est tout l'opposé: les cas où on rencontre des lésions sont de beaucoup les plus rares. Cette assertion paraîtra paradoxale à ceux qui ne connaissent des lésions nerveuses que *les trois ou quatre maladies qu'on observe dans les hôpitaux;* mais les affections nerveuses se comptent

par centaines, et pour ne parler que de ces grandes perturbations qui portent sur le mouvement, sur la sensibilité, sur l'intelligence, où est la lésion dans ces cas? La plupart du temps on n'en trouve aucune, ou celles qu'on observe n'ont aucun rapport avec les désordres fonctionels."

993. Eccentric epilepsy, traumatic tetanus, hydrophobia, &c. &c. leave no unequivocal uniform traces under the scalpel. The morbid appearances which have been observed are not constant, but occasional, *effects* of the disease. I shall presently bring before you the observations of M. Gendrin especially upon this point. We must study the *anatomy*, the *physiology*, the *symptoms;* we must distinguish the centric from the eccentric forms of these diseases,—their *effects* from the diseases themselves; and we must add to these points the all-important one of the therapeutics,—the study of the *causes* and *prevention* of paroxysms, &c. We shall thus be supplied with all the evidence of which the case admits, and be preserved from the errors of those pathologists who think the gross and brute mass of the morbid anatomy is every thing. We shall also be led to distinguish between curable and incurable forms of the same disease, or rather between different diseases unfortunately bearing the same name. I heard an amiable physician of Paris contend that epilepsy was invariably incurable. He did not distinguish the *centric* cases of that disease found in hospitals, workhouses, asylums, &c. from the *eccentric*, so frequently treated, and cured too, in private practice. For our own comfort, and for our patient's benefit, we must study these things with care.

994. It is interesting to observe how the pathology confirms the physiology and anatomy.

995. *Cerebral* diseases affect primarily the cerebral functions, and the true spinal functions consecutively. The diseases of the true spinal system induce changes in the excito-motory phenomena in the first place, and in the cerebral functions in the second. Cerebral diseases are generally more insidious in their progress than the true spinal, because slight aberrations of the cerebral functions are less observable than similar affections of the true spinal system; pain, vertigo, watchfulness, &c. are less striking than the slightest degree of convulsive movement or paralytic affection. It is on this account

that the *first* symptom *observed* in cerebral disease is frequently one belonging to the true spinal system, especially *vomiting*, perhaps *strabismus*.

996. The true spinal diseases, especially those of eccentric origin, affect, in a remarkable manner, the set of functions which I have noticed as belonging to this system: those of the eye and eye-lid; those of the larynx, of the pharynx; the respiration; the action of the expulsors and of the sphincters; that state of the muscles designated by the term *tone*. We must revolve in our minds the symptoms of epilepsy, of hysteria, of tetanus, of hydrophobia; the causes and phenomena of vomiting, of asthma, of abortion, of tenesmus, and of strangury, and we shall be forcibly struck with the justice of this remark. On the other hand, every convulsive effort affects the brain with congestion and its consequences, of which a fatal coma or effusion are not the least frequent. See p. 95.

997. I have recently read several Memoirs on the *Principles of Pathology in the Nervous System*, at the Royal Medical and Chirurgical Society. The first three are published in volumes xxii and xxiii. The objects of these Memoirs are to trace—1, the *Condition of the Irritability in the Muscles of Paralytic Limbs*; 2, the *Morbid Reflex* and *Retrograde Actions of the Spinal Marrow*; and, 3, the *distinct Influence of Volition, Emotion*, and the *Vis Nervosa*. The fourth was read on the 10th of November, 1840, and will probably appear in the next volume of the Transactions. I shall adduce these Memoirs in this place.

MEMOIRS

ON SOME PRINCIPLES OF PATHOLOGY IN THE NERVOUS SYSTEM.

MEMOIR I.—*On the Condition of the Muscular Irritability in Paralytic Limbs.*

Read April 9th, 1839.

998. FROM numerous subjects of investigation in reference to the Pathology of the Nervous System, I have selected, for the present communication, that of the condition of the muscular irritability in paralytic limbs.

999. The utmost discrepancy of opinion prevails amongst physiologists and medical writers upon this subject. Prochaska, Nysten, and Legallois state, that the irritability of the muscular fibre remains in paralytic limbs; whilst Professor Müller and Dr. Sticker assert the contrary. No attempt has been made to reconcile a contradiction not very honourable to our science. To explain this discrepancy of opinion is one of the objects of this communication.

1000. The authors to whom I have referred, misled by the generic term and idea of paralysis, have not sufficiently distinguished between its different species. Yet it will be found, as we proceed, that this distinction is of the utmost importance in the explanation of the phenomena. In fact, cerebral paralysis, or that which removes the influence of the brain, and spinal paralysis, or that which removes the influence of the spinal marrow, are in totally opposite conditions in reference to the irritability of the muscular fibre in the limbs severally affected; facts equally obvious in experiments and in clinical observations. I must begin this paper by quotations of some length; for these are necessary to show the present state of the science. I shall then proceed to the detail of my own investigations.

1001. The first distinct notice of this subject which I think it necessary to adduce, is contained in the following extract from the Opera Minora of Prochaska*:—" Vis nervosa quæ in nervis a commercio cum cerebro separatis superest, non unâ alterâve musculi contractione, quam irritati cient, exhauritur, sed millenis plane convulsionibus excitandis par est; quod expertus sum in ranâ, cui medullam spinalem in dorso abscidi. Supervixit huic vulneri aliquot diebus; interim irritando medullæ spinalis partam eam, quæ erat infra sectionem, convulsiones in artubus inferioribus excitavi toto tempore, quo supervixit, planè innumeras; neque extremitates inferiores prius mortuæ sunt, quam tota rana. Dein quod vis nervosa in nervis diu persistere possit citra cerebri auxilium probare videntur musculi paralytici, in quorum nervis ob compressionem aliquam præternaturalem totum commercium cum cerebro sublatum est, nihilominus tamen à stimulo electricæ scintillæ longo jam tempore paralytici musculi convelluntur."

1002. More detailed remarks were made by Nysten, and these, from being founded upon very distinct post-mortem experiments on the human subject, have excited more attention. This celebrated physiologist observes—" Chez deux apoplectiques qui avaient succombé au bout de quelques jours, l'un à la première attaque et l'autre à la seconde, le galvanisme a déterminé des contractions aussi forte dans les muscles du côté sain que dans ceux du côté paralysé : les iris des deux côtés sont également contractées." " Cette propriété n'a été complètement anéantie dans les organes musculaires des deux sujets qu'environ douze heures après la mort; et on n'a observé aucune différence dans les muscles paralysés†."

1003. Legallois makes similar remarks, founded upon experiments made upon animals. He observes—" M. Nysten a montré que dans les paralysies les plus complètes, l'irritabilité se conserve dans les membres paralysés tout aussi bien que dans ceux qui ne le sont pas. J'ai obtenu un résultat semblable d'une expérience que j'ai souvent répétée. Elle

* Ed. 1800, p. 84.

† Recherches Physiologiques, 1811, p. 369; compare p. 377 and 419; and Cuvier, Histoire des Sciences Naturelles, tome i, p. 213.

consiste à détruire la moëlle lombaire dans un lapin âgé de moins de dix jours ; il faut le choisir de cet âge, pour que la circulation ne soit pas arrêtée, et qu'il puisse continuer de vivre. Quoique dans cette expérience, le train de derrière soit frappe de mort, et que ses nerfs ne puissent plus recevoir aucune influence de la moëlle épinière, l'irritabilité s'y conserve, et l'on peut, pendant fort long-temps, faire contracter les cuisses, en irritant les nerfs sciatiques. Il parait donc qu'il se fait dans toute l'étendue des nerfs une sécrétion d'un principe particulier*."

1004. From these quotations from Nysten and Legallois, we should be led to the conclusion, that the muscles of paralytic limbs, in all cases of hemiplegia and of paraplegia, simply retain their irritability. From another series of observations, made by philosophers equally worthy of our confidence, we should be led to an opposite conclusion.

1005. Some interesting experiments on this point have been recently performed by Professor Müller and Dr. Sticker. The former† celebrated physiologist observes — "It was known that, after the division of a nerve, the portion cut off from communication with the brain retains, for a certain time, its excitability; but the question, how far the continuance of the connection with the brain and spinal marrow is necessary for the longer preservation of the irritability of the nerves, and whether the muscles retain their irritability when their nerves no longer communicate with the central parts of the nervous system—could not hitherto be answered with certainty, and had, indeed, been seldom mooted. Nysten had asserted that the muscles of patients who died a short time after an apoplectic seizure preserved their irritability, and contracted under the influence of the galvanic stimulus, although the functions of the brain had been paralysed.

1006. "I had good reasons, however, for believing that, in such cases, the nerves retain their power only for a short time, losing it entirely after a longer interval; for, in expe-

* Œuvres de Legallois, ed. 1824, p. 23 and 24.

† See the excellent translation of the "Handbuch der Physiologie," by William Baly, M.D. vol. i, p. 631–633; and compare p. 663, 724, 727, 898, &c. and Grainger on the Spinal Cord, p. 96, 97.

riments on the reproduction of the nervous tissue in a rabbit, I had once observed that the lower portion of the nervus ischiaticus, which I had divided some months previously, had lost all its excitability; and a similar fact had been before observed by Fowler. I have since performed, in conjunction with Dr. Sticker, new experiments, which have completely confirmed that supposition. To prevent the regeneration of the nerves, and to withdraw more effectually the lower portion from the influence of the brain and spinal cord, a portion of the nerve (the ischiatic) was entirely removed. The experiments were made only on two rabbits and a dog; yet the results were so constant, that they are quite worthy of dependence.

1007. "Eleven weeks after the division of the nerve in the first rabbit, it was laid bare in its course between the biceps and semitendinosus muscles. Contrary to expectation, and to our mortification, the continuity of the nerve was found to be restored. It was divided anew below the cicatrix; and it is remarkable that, although the animal uttered a loud cry, the section excited no contraction of the muscles. The lower portion of the nerve was now exposed to the galvanic stimulus of a single pair of plates, was cut and pulled in every possible way, but not the slightest muscular contraction was excited.

1008. "For the sake of comparison, the nerve of the opposite side was divided, when the animal showed signs of suffering the most severe pain, and violent muscular spasms took place; and, after the division, very slight irritation of the nerve itself, that is to say, of the lower portion of it, or merely of the muscles, excited strong twitchings, even after death.

1009. "Ten weeks after the division of the nerve in the dog, the ends were found to be reunited. The experiment was performed exactly as in the rabbit, and the result, as to the effect on the nerve, was entirely similar: it had lost all its excitability; but the muscles still contracted slightly when stimuli were applied directly to them immediately after death: however, this remaining irritability was gone, while, in the muscles of the opposite leg, the strongest contractions could be excited.

1010. "Five weeks after the nerve had been divided in

the second rabbit, we proceeded to examine its state, and were the more interested on account of the short time that had elapsed since its division. The ends were not united; they were somewhat swollen, and connected with the surrounding cellular tissue. In the other instances, the portion of nerve removed measured about four lines only; here its length was eight lines. No contraction of the muscles could be excited by irritating the nerve either mechanically or by a chemical stimulus, caustic potash, or by galvanism; nor by irritating the muscle itself, although the rabbit had plenty of vital power. On the left side, the muscles were found irritable, as in other cases, both before and after death.

1011. "The foregoing experiments prove, at least, that when the communication of the nerves with the brain is wholly cut off, they gradually lose the power of exciting the muscles to contraction, while the muscles lose their irritability. The result would, however, have been still more decisive if, in place of a single pair of plates, a small galvanic battery had been employed to stimulate the nerves and muscles. That, and that alone, would have enabled us to determine with certainty whether all the power of the muscles, in two of the cases, had been lost. The experiments as they were made, however, prove distinctly enough the necessity of communication with the brain for the preservation of nervous and muscular power. We may from them conclude also that if, after the division of a nerve, the excitability of the lower portion, and the irritability of the muscles are restored, the nerve has itself been completely reproduced; and that this has not been the case if the nerve and muscle do not retain their vital properties."

1012. I may here observe, that an experiment, similar to those of Professor Müller and Dr. Sticker, in which Sir Astley Cooper assisted the late Dr. Haighton, was made in this country many years ago, but never published. The sciatic nerve was divided in a dog. In a few days the lower portion had lost its power of exciting muscular contraction.

1013. These statements appear, then, sufficiently opposed to each other; how shall we explain or reconcile them? Before I proceed to discuss this question, I must beg the attention of the Society to a third series of observations and ex-

periments, in a certain sense at variance with both those which have been detailed.

1014. My own attention was first drawn to this interesting point by the fact, well known to physicians, that if we administer strychnine to patients affected with paralysis, it is frequently the paralytic limbs which first manifest the peculiar influence of this powerful remedy. M. Fouquier has, I believe, too hastily generalized this effect of strychnine on the muscles of paralytic limbs. And how well do I remember the same remark being made by M. Louis, as, in our visit round his wards at La Pitié, we came to a case in point. From that moment I did not cease to revolve the question in my mind, and to devise modes of observation and experiment to solve it. Certainly the conclusion of M. Ségalas in regard to it, is anything but satisfactory. M. Ségalas observes :—

1015. "Ces expériences réunies autorisent donc à conclure que le tétanos produit par la noix vomique a pour condition première de son développement la présence du poison dans le sang, et que les phénomènes qui l'accompagnent sont dus à l'action anormale de ce fluide sur le système nerveux."

1016. "Cette manière de considerer l'action de la noix vomique donne un moyen simple d'expliquer les effets de cette substance chez l'homme, et particulièrement ce fait si remarquable de la contraction des muscles paralysés plus prompte et plus énergique que celle des muscles sains, fait observé d'abord par M. Fouquier,* et constaté depuis par tant de praticiens du premier ordre. Il est facile, en effet, de concevoir que les muscles sains, soumis à la fois à l'empire du cerveau et à l'action du poison, résistent à celle-ci plus que les muscles paralysés, qui, soustraits à l'influence cérébrale, ne sont plus commandés que par le poison."

1017. Upon these observations of M. Ségalas, M. Ollivier remarks—"Mais s'il en est ainsi, comment se rendre raison d'un fait observé depuis long-temps par tous les praticiens, et sur lequel je viens d'appeler l'attention, c'est que la noix vomique cause souvent de violentes douleurs dans les mem-

* Mémoire sur l'emploi de la noix vomique dans les paralysies, par M. Fouquier; 1815.

bres paralysés, sans apporter aucun trouble dans les parties saines ? Pourquoi cette action spéciale sur les seuls organes paralysés ? et, d'un autre côté, la douleur perçue ne prouve-t-elle pas que les parties paralysés ne sont point isolées entièrement du centre nerveux, et qu'ainsi ce ne peut être à cette inconstance qu'on doive attribuer la localisation singulière des effets de la strychnine *? "

1018. It will soon be seen that this view, like a former one, is far too general, far too indiscriminate—that it is not in every case of paralysis that the strychnine would first display its influence on the paralytic limbs. Meantime, however, I figured to myself the fact of the strychnine acting on the spinal marrow, and diffusing its power equally along the nerves, to the right hand and to the left, to the muscles to which they proceed respectively; and I asked myself the question—Is the difference observed in its ultimate effects on those muscles, the power being obviously the same, owing to a difference in the degree of irritability of the muscular fibre itself? Is the irritability of that fibre actually augmented? If so, the phenomenon would be explained?

1019. I waited with anxiety for opportunities of submitting this question to the decision of experiment. This I entrusted, in the first instance, to my young friend and intelligent pupil Mr. Dolman. The result was as I anticipated. A little child, aged two years, was perfectly paralytic of the left arm. The slightest shock of galvanism was directed to be applied which should produce an obvious effect. It was uniformly observed that the paralytic limb was agitated by a degree of galvanic energy which produced no effect on the healthy limb.

1020. A similar patient, with paralysis of one leg, was subjected to the same experiment by my friend and former pupil Mr. W. F. Barlow, and with the same result.

1021. I repeated the trial on several patients affected with hemiplegia, at my own house, uniformly with the same event; the paralytic limbs were always moved by an influence which was lower than that required to affect the healthy limb, or if both limbs were agitated, it was uniformly the paralytic limb which was more shaken than the other.

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* Traité de la Moëlle Epinière, 1827, p. 841.

1022. I next repeated my observations upon a more extensive scale, at the St. Mary-le-bone and St. Pancras Infirmaries. There were two exceptions to the rule; whilst the numbers in which the phenomena already described were observed, were considerable.

1023. These exceptional cases I shall notice particularly hereafter. I must now remark that these observations seem, even more than those of Prochaska, Nysten, and Legallois, at variance with the experiments of Professor Müller and Dr. Sticker. Before I proceed to discuss this question, I must, however, detail some experiments of my own.

1024. They were made on six frogs. I divided the spinal marrow immediately below the origin of the brachial plexus; and I removed a portion of the ischiatic nerve of the right posterior extremity. I had immediately, or more remotely, the following interesting phenomena.

1025. 1st. The anterior extremities alone were moved spontaneously; both posterior extremities remaining entirely motionless, when the animal, placed on its back, made ineffectual efforts to turn on the abdomen.

1026. 2nd. Although perfectly paralytic in regard to spontaneous motion, the left posterior extremity, that still in connexion with the spinal marrow, moved very energetically when stimulated by pinching the toes with the forceps.

1027. 3rd. The right posterior extremity, or that of which the ischiatic nerve was divided, was entirely paralytic, both in reference to spontaneous and excited motions.

1028. 4th. After the lapse of several weeks, whilst the muscular irritability of the left posterior extremity was gradually augmented, that of the right was gradually diminished, phenomena observed when the animal was placed in water, through which a slight galvanic shock was passed accurately in the direction of the mesial plane.

1029. In this interesting experiment we have, then, first the phenomena of loss of spontaneous motion on removing the influence of the brain, the excited or reflex actions remaining; and the loss of these on removing the influence of the spinal marrow; secondly, in the case of mere cerebral paralysis, we have augmented irritability, and in that of the spinal marrow we have the gradual diminution of this property.

1030. 5th. Strychnine being now administered, the anterior extremities and the left posterior extremity, or that still in connexion with th spinal marrow, became affected with tetanus; but the right posterior extremity, or that severed from all nervous connexion with the spinal marrow, remained perfectly flaccid.

1031. 6th. Lastly, the difference in the degree of irritability in the muscular fibre of the two limbs was observed, when these were entirely separated from the rest of the animal.

1032. In a word, the muscles of the limb paralysed by its separation from both cerebrum and spinal marrow, had lost their irritability; whilst those of the limb separated from its connection with the cerebrum only, but left in its connection with the spinal marrow, not only retained their irritability, but probably possessed it in an augmented degree. The next question came to be,—Do these phenomena obtain in the human frame? I visited a patient affected with hemiplegia, including paralysis of the face, and I passed a slight galvanic shock through two pieces of metal, of which one was placed over each cheek. The muscles of the paralytic side were most affected. I repeated the experiment with the same result. I now compared with these, two cases of injury of the facial nerve, passing the galvanic shock in the same manner through the fibres of the orbicularis: it was now the muscle of the healthy side which was affected by the galvanism, the eye-lid of that side being closed, whilst that of the paralytic side gaped as before. I next compared the effect of galvanism in two cases of complete paralysis of the arm, one hemiplegic, the other the result of dislocation of the shoulder. The muscles of the former were more, those of the latter less, irritable than those of the healthy arm respectively, as were also those of the arm of a patient affected with the paralysis induced by lead. Lastly, I compared two cases of paralysis of the lower extremities, one arising after pertussis, and therefore cerebral, the other, I think, from disease within the lumbar vertebræ: in the former there was augmented, in the latter diminished, irritability.

1033. By means of these experiments and observations we are enabled, I believe, to explain all the apparent discrepancies

between the statements of former authors, and between each of them and my own.

1034. The observations of Nysten, and others, determined that the irritability of the muscular fibre still existed in ordinary hemiplegia; but they did not extend far enough to determine the comparative degree of irritability of the paralytic and of the healthy limbs, or the question whether, in the former, the irritability was diminished—the event probably expected—or augmented, a result, I believe, never anticipated.

1035. Prochaska and Nysten and Legallois failed in their experiments, too, by not allowing time for the change in the condition of the irritability of the muscular fibre to take place.

1036. Professor Müller and Dr. Sticker, on the other hand, did not distinguish between paralysis arising from separation from the cerebrum merely, and paralysis arising from separation from the spinal marrow, a distinction of the utmost importance in every point of view, and that which explains the phenomenon under discussion. The term paralysis has been used, by all the authors whom I have quoted, in too general a sense. This is so true, that I may affirm that in one kind of paralysis, that which removes the influence of the cerebrum, and which is therefore paralysis of spontaneous or voluntary motion, there is augmented irritability; whereas, in the other, that which severs the influence of the spinal marrow, the irritability is diminished, or even annihilated.

1037. We may conclude that, in cerebral paralysis, the irritability of the muscular fibre becomes augmented, from want of the application of the stimulus of volition; in paralysis arising from disease of the spinal marrow and its nerves, this irritability is diminished, and at length becomes extinct, from its source being cut off.

1038. We may further deduce, from the facts which have been detailed, that the spinal marrow, and not the cerebrum, is the special source of the power in the nerves of exciting muscular contraction, and of the irritability of the muscular fibre; that the cerebrum is, on the contrary, the exhauster, through its acts of volition, of the muscular irritability.

1039. As a further deduction from the same facts, we may infer the diagnosis between cerebral and spinal paralysis:

mere cerebral paralysis is attended by augmented irritability, whereas spinal paralysis is that which is attended by diminished irritability. This fact will prove useful in many obscure cases.

1040. Having thus cleared up the physiological question, I proceed to the application of the principle to pathology; and I may here observe that there is a whole series of phenomena which admit of explanation by its aid.

1041. And, first, the exception to the rule of augmented muscular irritability in paralytic limbs, is obviously dependent upon its existing in the cases of paralysis from the severed influence of the spinal marrow, as distinguished from those arising from the severed influence of the cerebrum merely.

1042. Secondly, we understand at once why the influence of strychnine is first, and most, seen in cerebral paralysis, in the paralytic limbs.

1043. But there are still some other points which I must bring before the notice of the Society.

1044. The first of these is the influence of emotion in paralytic limbs.

1045. The second is the similar influence of certain acts of respiration; as yawning, sneezing, coughing, &c.

1046. The third, the similar influence of the tonic power.

1047. It must have occurred to us all to observe the influence of surprise or agitation on the arm and hand, and perhaps on the leg, of a patient long affected by hemiplegia, whilst the limbs of the healthy side remained unaffected. In this case the influence of the emotion is, like that of strychnine in the case formerly discussed, exerted equally upon the limbs of both sides; but it is the muscles of the paralytic limbs which are most irritable, most susceptible of the stimulus; it is therefore these limbs which are most convulsively affected.

1048. The same phenomenon is not observed in paraplegia, because the influence of the emotion is cut off from the affected limbs.

1049. *Case* 1.—I was called to a patient a short period ago, affected at that moment with bronchitis. He was forty-three years of age; and at the age of twenty-four had been seized with hemiplegia. Recovering from the immediate danger of the attack, he remained hemiplegic, scarcely regaining the use of the hand and arm at all, and only partially that of the leg.

1050. Whenever this patient is excited by meeting an acquaintance, or in any similar way, he has a little strabismus, and the hand and arm are contracted and convulsed in the most extraordinary manner: whenever he coughs, the leg is thrown involuntarily upwards. The arm is severed, as it were, from volition, but effected by emotion.

1051. Similar facts have been observed in regard to the influence of certain respiratory acts, but especially those of yawning, sneezing, &c.

1052. Dr. Abercrombie details the following interesting case in a note to the late Mr. Shaw:

1053. "I think the following case will be interesting to you and Mr. Bell. I had some time age under my care a man affected with hemiplegia of the left side; the palsy complete, without the least attempt at motion, except under the following circumstances: he was very much affected with yawning, and every time he yawned the paralytic arm was raised up, with a firm steady motion, until it was at right angles with his body (as he lay in bed on his back), the fore-arm a little bent inwards, so that his hand was above his forehead at its greatest elevation. The arm was raised steadily during the inspiration, and, when the expiration began, seemed to drop down by its own weight, with considerable force. He continued liable to the affection for a considerable time, and it ceased gradually as he began to recover the natural motion of the limb."—That is, as I conclude, as the state of augmented irritability was removed by the returning acts of volition.

1054. No less interesting are the effects of the tonic power. In cases of hemiplegia of long duration, the paralytic limbs, but especially the arms and hands, are drawn into a state of chronic, rigid, contraction. This phenomenon is owing to the principle of tone constantly acting upon muscles now possessing augmented irritability, whilst they are never, or rarely, relaxed by acts of volition.

1055. A similar effect is seen in idiots born with atrophied cerebrum: the influence of volition is wanting; that of the spinal marrow, the source, at once, of the tone and of the irritability of the muscular system, is in constant action, and induces chronic contraction; an effect which must, however, be distinguished from that of spasm, which is excited immediately by some disease of the spinal marrow itself.

1056. I may now resume the subject of the action of strychnine on paralytic limbs. It is obvious that the generalization of M. Fouquier, M. Ségalas, and others, that the strychnine attacks the paralytic rather than the healthy limbs, was too hasty. This is only true in those cases of paralysis in which the muscles still remain in nervous connection with the spinal marrow; the opposite result is observed in those other cases in which such connection between the muscles and the spinal marrow is intercepted.

1057. I would here make another observation. The arms and hands, generally speaking, are more under the influence of the cerebrum than the lower extremities; and these, on the other hand, are more under the influence of the spinal marrow than the arms and hands. The superior extremities are more, and more frequently affected by hemiplegia than the inferior: these are more influenced by tetanus, by strychnine, &c. than the former; a fact which I have observed, in regard to strychnine, in some cases of hemiplegia. These facts must be borne in mind in making our observations.

1058. Another circumstance must also be noticed. The more perfect the paralysis, generally speaking, the more the irritability of the muscular fibre is augmented. In hemiplegia, the arm is generally at once more paralytic and more irritable than the leg. In chronic cases, however, the irritability becomes impaired, together with the nutrition.

1059. I will now adduce a few cases which, however succinctly detailed, will exemplify and substantiate the preceding observations.

1060. *Case* 2.—On January the 16th, 1839, I visited a patient who had been seized with hemiplegia nine months before: the arm was perfectly paralytic, the leg less so, the face less so still. On passing the galvanic influence through the arms, the left or paralytic arm was much more affected than the right, and distinctly affected by a force which induced no effect whatever on the right, the tendons starting on each completion of the galvanic circle; the contraction of the muscles of the left side of the face was seen in its effect on the features: and that of the left gastrocnemius, in its effect on the tendo Achilles, when no effect was perceptible on the right side of the face, or in the right leg.

1061. In this patient, other and very interesting phenomena were observed:

1062. 1st. The arm has, from the beginning, been much more paralytic than the leg or the face:

1063. 2nd. The influence of strychnine was observed in the paralytic arm and leg only; in the latter more than in the former:

1064. 3rd. Any sudden noise, or other causes of emotion, affect the paralytic side only—the leg, however, more than the arm:

1065. 4th. Yawning and sneezing move the paralytic limbs; the former the arm, the latter the leg, principally:

1066. 5th. The act of stretching, and the act of raising the right arm above the head, induce unconscious movements of the left or paralytic arm:

1067. 6th. During sleep, the left or paralytic arm and hand are greatly contracted and painfully pressed to the side:

1068. 7th. The paralytic arm shrinks from the application of cold, as the sudden contact of a cold hand; an example of the reflex action in hemiplegia:

1069. 8th. Lastly, the paralytic hand and arm are constantly in a state of contraction.

1070. I repeated the trials with the galvanic shock, with the same results, on February the 14th.

1071. *Case* 3.—On January the 15th and 22nd, 1839, I passed a slight galvanic shock through the orbicularis of each side of the face, in a patient affected with paralysis of the left facial nerve from exposure to cold, of six weeks' duration. Here the right eye-lid was forcibly closed, the left or paralytic eye-lid being totally unaffected.

1072. *Case* 4.—On February the 13th, I passed the galvanic shock through the two orbiculares in a patient whom I visited with Mr. Burford, and in whom the facial nerve was partially paralyzed by the removal of a considerable branch of the nerve, together with a tumor which had formed in its course along the cheek.

1073. The muscle of the paralytic side was unaffected, whilst that of the healthy side closed the eye-lids on every application of the galvanic influence.

1074. *Case* 5.—I have more recently performed the same

experiment on a patient affected with paralysis of the facial nerve, from otitis and disease of the temporal bone, with precisely the same result.

1075. *Case* 6.—On February the 9th, I compared the influence of the galvanic shock in two patients at the St. Pancras Infirmary; both were affected with complete muscular paralysis of the arm; the first case was cerebral, being hemiplegia; the second was injury of the brachial plexus, having resulted from dislocation of the shoulder; the results were what I had anticipated; in the case of hemiplegia, the irritability of the muscles of the paralytic limbs was greater than that of the muscles of the healthy limb. In the case of injured brachial plexus, the opposite state of things was observed, the irritability of the muscles of the paralytic hand and fore-arm being greatly diminished.

1076. *Case* 7.—On January the 23rd, 1839, I passed the galvanic shock through the hands of a patient who had been gradually affected with paralysis of the right, from handling leaden types as a compositor. Here again the paralytic muscles were unaffected by a degree of galvanism which induced an evident effect on the muscles of the healthy limb.

1077. *Cases* 8 *and* 9.—On January the 10th, 1839, I galvanized a little boy with paralysis of the left leg; the muscles were more irritable than those of the healthy leg; the affection had followed pertussis, and I concluded that it was cerebral. This conclusion was confirmed by a fact which I learnt afterwards; viz. that, in the commencement, there was imperfect closure of the eye-lids during sleep. On the same day I tried the galvanic influence in a case of partial paraplegia in a little girl, a patient of Mr. Burford. In this case the muscles of the paralytic limbs were less irritable than those of the healthy limbs. I concluded that the disease was seated in the course of the nerves, and probably within the lumbar vertebræ.

1078. *Case* 10.—It has been suggested to me, that the loss of irritability in the cases of spinal paralysis might be owing to defective nutrition of the muscles. I therefore tried the effect of galvanism in a case of chronic cerebral paralysis, or hemiplegia, with much emaciation of the paralytic muscles. I found these muscles, as before, much more irritable than those of the unaffected limb.

1079. I must repeat that I am perfectly aware of the sketchy manner in which these notes of cases are given; but I thought it better to leave the further details for another kind of communication to this Society.

1080. In the mean time we may conclude, that, by the test afforded by the galvanic trough, we are enabled to effect a diagnosis between the cases to which I now allude. Disease of the cerebrum itself,—disease of the dorsal portion of the spinal marrow,—induces cerebral paralysis, hemiplegia, or paraplegia; disease compressing or destroying the facial nerve, or the cauda equina in the lumbar region, induces both cerebral and spinal paralysis. In the former case we shall observe augmented, in the latter diminished, irritability of the muscular fibre.

1081. This conclusion is generalized in *Plate* I, *fig.* 1. In all cases of paralysis represented by the lines A B, C D, E F, &c. the influence of the cerebrum is removed, that of the spinal marrow, the source of the excitor power in the nerves, and of the irritability of the muscular fibre, remaining: we have, therefore, augmented irritability. In all cases of paralysis represented by the lines G H, H I, the influence of the spinal marrow itself is removed: we have, therefore, diminished irritability. These lines may be designated lines of cerebral, or of spinal, paralysis, respectively.

1082. I may now resume the points of this paper, and observe,

1083. 1st. That the spinal marrow, exclusive of the cerebrum, is the source of animal life. The irritability of the muscles, of organic life, depends probably on the ganglionic system.

1084. 2nd. That the cerebrum is, in its acts of volition, an exhauster of that irritability:

1085. 3rd. That, in muscles separated from their nervous connexion with the brain, we have augmented irritability:

1086. 4th. That in muscles separated from their nervous connexion with the spinal marrow, we have, on the contrary, diminished irritability:

1087. 5th. That the degree of the irritability of the muscular fibre of paralytic limbs, compared with that of the muscles of the healthy limbs, will afford us a source of dia-

gnosis between cerebral and spinal paralysis, and especially between

1. Hemiplegia of the face, and
2. Paralysis of the facial nerve;
3. Hemiplegia of the arm or leg, and
4. Disease of the nerves of these limbs*;
5. Disease of the spinal marrow in the dorsal region, and
6. Disease of the caudo equina in the lumbar region; &c.

1088. 6th. That the greater influence of emotion, of certain respiratory acts, of the principle of tone, &c. on the muscles of certain paralytic limbs, depends on their augmented irritability:

1089. 7th. That the same principle explains the greater susceptibility of the muscles, in certain cases of paralytic limbs, to the influence of strychnine:

1090. 8th. That, in the conclusions of M. Fouquier, Professor Müller, &c. a sufficient distinction was not made between the influence of the cerebrum and spinal marrow, which in this, as in so many other respects, have such different properties:

1091. 9th. From these, and other experiments and observations, I conclude, too, that sleep restores the irritability of the muscular system, by arresting the acts of volition, which exhaust or diminish it; muscular efforts, on the other hand, diminish the irritability and induce fatigue.

1092. I may again observe, in conclusion, that I have purposely avoided giving cases in detail. I wished, in this communication, to restrict myself to principles: in a future one, I may supply the defect to which I have alluded. On an early occasion, I propose to lay before the Society, in a second Memoir, the results of my observations—1st, on the reflex action in certain cases of paralysis, tetanus, &c.; and, 2nd, on the retrograde action in certain cases of disease of the spinal marrow.

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* In disease of the cervical vertebræ, the arms are sometimes paralyzed without paralysis of the legs; this probably arises from compression of the brachial plexus. See Sir B. Brodie's paper in the Transactions of this Society, vol. xx. p. 130: the galvanic trough would determine the question.

Memoir II.—*On the Morbid Reflex and Retrograde Actions of the Spinal Marrow.*

Read February 25th, 1840.

1093. I proceed to fulfil my promise of the last session * to lay before the Society the result of my observations on the singular phenomena of the reflex and retrogade actions of the spinal marrow observed in various diseases. I shall first treat of

I. *The Reflex Actions.*

1094. I need scarcely recal to the attention of the members of this Society, the series of *experiments* related by Redi, Whytt, Legallois, Blane, Mr. Mayo, &c. or my own, relative to this interesting subject. But I must briefly advert to the principle of action, with its newly discovered laws, upon which these experimental phenomena depend, and to the extension of that principle to physiology—to the physiology of ingestion and egestion in the animal economy, which are the results of my own investigations.

1095. In treating of certain muscular motions, produced by the irritation of muscular nerves, Haller distinctly speaks of two principles of those motions—the motive power residing in the nerve, which he designates the *vis nervosa*, and the moving power residing in the muscle, which he designates irritability or the *vis insita*.

1096. Of the *vis nervosa*, Haller†, Bichat‡, and Professor Müller §, all most distinctly state, that it acts in *one* direction only, viz. that *from* trunk *to* branch, or *from* the nervous centres *towards* those parts of the muscular system placed in relation with them.

1097. It is obvious that, if this conclusion were well founded, there could be no *reflex* action of the *vis nervosa*, nor any application of this principle to physiology,—a very improbable circumstance, *à priori*.

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* See the Transactions of this Society, vol. xxii, p. 217.

† Elementa Physiologiæ, Lausanne, t. iv. p. 325.

‡ Anatomie Générale, 1801, t. iii, p. 277.

§ Handbuch der Physiologie, 1834, i, p. 656.

1097. At the same time it appeared to me that, when I had established that the reflex actions did not depend upon sensation and volition, but upon some other principle of the animal œconomy, the only known principle which remained, and which could be the probable agent in these actions, was the *vis nervosa*. I resolved therefore to institute a new series of experiments in order to determine the question, whether the *vis nervosa* were susceptible of other and unsuspected modes of action. To these experiments I will advert very briefly. They afforded the most satisfactory proof that my conjecture was correct, and, in a word, that the motor principle of the reflex actions was discovered.

1098. These experiments consist in denuding and stimulating the lateral nerves in the decapitated turtle. Contrary to the law laid down by Haller, Bichat, and Professor Müller, the *vis nervosa*, being excited, acted in an incident direction, that is, *from* branch *to* trunk, and both *upwards* and downwards, and, being *reflected* on the muscles, induced movements in both the anterior and posterior extremities.

1099. It results from these and other experiments, relative to the *vis nervosa*,

1100. 1. That it acts in *direct* lines *along* the spinal marrow, and *from* the trunks *to* the branches of the nerves, and *to* the muscles they supply,—according to the law laid down by Haller, Bichat, and Professor Müller.

1101. 2. That it acts in *reflex* directions *to* and *from* the spinal marrow; that is, *from* peripheral, cutaneous, and mucous surfaces, *through* the spinal marrow, and *to* the co-ordinated muscles, according to a newly discovered law; and, as will be seen hereafter,

1102. 3. That it acts in a *retrograde* direction along the spinal marrow.

1103. Such being the principle on which the reflex actions depend, the next question for this Society is,—in what circumstances are they most manifested in the human frame? From much investigation I am enabled to state, that, in order that the *reflex* actions may be very apparent, it is essential

1104. 1. That the interference of *volition* should be removed;

1105. 2. That the *vis nervosa* and the *vis muscularis* should be unimpaired, not to say augmented; and

1106. 3. That the *reflex nervous arcs* should be uninterrupted.

1107. 1. That volition interferes with some of the phenomena of the reflex function is obvious from some of the phenomena of sleep and of comatose and paralytic affections. This first principle I had long ago observed; but it is to Mr. W. F. Barlow that the profession is indebted for its more complete development, in a lecture which he delivered during the last winter, to the students at Sydenham College. Several of Mr. Barlow's observations are extremely interesting: he observes, "I gently passed my finger over the palm of the hand of a child who was fast asleep; the fingers contracted and embraced it tightly, and I could draw the arm away or raise it up, so firm was the grasp. The child having awaked, I again touched its hand as before, but no closure of the fingers was induced." This simple experiment beautifully demonstrates the activity of the excito-motory function during sleep, and the counter influence of volition in the waking state. Mr. Barlow added, "I have remarked that spasmodic actions are induced in limbs paralysed as to voluntary motion, by stimuli which have no such effect on limbs still under cerebral influence."

1108. It is on a similar principle that in cerebral paralysis the reflex actions are most observed in those cases in which the paralysis is most complete.*

1109. 2. The first effect of a violent experiment or accident seems to be to suspend the *vis nervosa*, the *vis muscularis*, or both. It is accordingly observed that *immediately* after the division of the spinal marrow, in an experiment, or *immediately* after injury sustained by the same organ in the human subject, by a fall or other accident, the reflex actions subsequently developed and manifested most clearly, are not observed.†

1110. The nervous and muscular powers are gradually

* See the Transactions of this Society, vol. xx.

† Ibid. vol. xxii, p. 183.

restored from this suspension, the effect of shock, and, at a still more remote period, even acquire an anormal degree of intensity. The phenomena dependent on them are augmented proportionately. The same remark is still more true in regard to cases in which the *vis nervosa* is morbidly augmented by disease, as in tetanus, hydrophobia, certain affections of the spinal marrow, in the effects of strychnine, &c. In these latter cases the slightest cause of excitement is reflected with terrific energy upon the appropriate parts of the muscular system.

1111. 3. Lastly, it is essential that the reflex nervous arcs should be entire. It has been observed that in some cases of paraplegia the reflex actions are present, in others absent. A slight knowledge of the anatomy of the spinal column is sufficient to explain this apparent discrepancy. If the disease be seated within the *cervical* or *dorsal* vertebræ, the spinal marrow in this part is affected, but a portion *below* may remain free from the influence of the disease; the reflex arc which involves this portion may, therefore, be entire, and the reflex actions will be observed. If, on the contrary, the disease be situated within the *lumbar* vertebræ, the cauda equina is affected, the centre of every reflex arc is excluded, and all the reflex actions will be absent.

1112. In fact, the lines of *cerebral* and of *spinal* paralysis, drawn in the sketch given in my former Memoir, (see *Plate* II, *fig.* 1) have their application in the question before us. In cerebral paralysis, we have reflex phenomena; in spinal paralysis these phenomena are absent. Disease seated in the course of the lines A B, C D, E F, leaves the subjacent reflex arcs and their functions entire; whereas disease situated in the course of the lines G H, H I, excludes the centres of the reflex arcs and their phenomena respectively.

1113. Very early in this investigation, I observed, that if the spinal marrow of a frog was divided between the anterior and posterior extremities, the head and the anterior extremities alone were moved spontaneously and with design, the respiration being performed as before; but the posterior extremities were not paralysed: they were drawn up and remained perfectly motionless, indeed, unless stimulated; but, by the application of any stimulus, they were moved with

energy, but once only, and in a manner perfectly peculiar. The stimulus was not felt by the animal, because the head and anterior extremities remained motionless at the time it was applied. Nothing could be more obvious, and indeed striking, than the difference between the phenomena of the functions of sensation and volition observed in the anterior part of the animal, and those of the reflex function exclusively in the posterior. In the former there were repeated spontaneous movements, with obvious design; in the latter, movements which were the mere and immediate effect of stimulus.

1114. The same experiment was made upon the toad; but it did not succeed so uniformly in this animal as in the frog. This circumstance is explained by a reference to the comparative anatomy of the frog and toad. As M. Desmoulins observes, "in the frog the insertion of the lumbar nerves takes place *lower* than in the toad by one fifth of the length of the spinal canal*." In the experiment on the frog, the *spinal marrow* was divided; in the toad it was the *cauda equina*. In the latter case, the *key-stone* of the incident and reflex arcs was therefore excluded; the effect of which is now readily understood. Is it not interesting to see physiological facts, unintelligible at first, explained by reference to the anatomy, and thus throwing a ray of light upon our pathological investigations?

1115. The very same explanation applies to the cases of paraplegia, unattended by the phenomena of the reflex excito-motory action. The disease is seated *below* the termination of the spinal cord; it is therefore a disease of the *nerves*, and represented by the line H I. The influence of both nervous centres, of the cerebrum, and of the true spinal marrow, is removed, and there are both cerebral and spinal paralysis, and the absence of reflex phenomena.

1116. When M. Magendie divided the fifth pair of nerves within the cranium, the *proof* that the division was complete, was obtained by observing that the eye-lids did not close when the eye-lashes were touched. In disease of the portio dura, the same phenomenon is observed. In experiments on the horse, detailed elsewhere†, the eye-lids lost their reflex

* Les Systèmes Nerveux, tome i, p. 187. † Memoirs, p. 61, § 67.

action when the medulla oblongata was destroyed. In all these three cases the continuity of the reflex arc is severally interrupted, in its incident, central, and reflex portion.

1117. The same mode of reasoning applies to the other cases of paralysis, in which the reflex actions are absent.

1118. The nervous arcs through which reflex actions may take place are shown in the following

TABLE OF THE ANATOMY OF THE TRUE SPINAL SYSTEM.

I. *The Incident Motor Branches.*

1. *The Trifacial, arising from—*
   1. *The Eye-lashes.*
   2. *The Alæ Nasi.*
   3. *The Nostrils.*
   4. *The Fauces.*
   5. *The Face.*
2. *The Pneumogastric, from*
   1. *The Pharynx.*
   2. *The larynx.*
   3. *The Bronchia.*
   4. *The Cardia,—Kidney, and Liver.*
3. *The Glosso-Pharyngeal?*
4. *The Posterior Spinal, arising from—*
   1. *The General Surface.*
   2. *The Glans Penis vel Clitoridis.*
   3. *The Anus.*
   4. *The Cervix Vesicæ.*
   5. *The Cervix Uteri.*

II. *The True Medulla Oblongata and Medulla Spinalis, the Centre of the System.*

III. *The Reflex, Motor Branches.*

1. *The Trochlearis* } *Oculi.*
2. *The Abducens* }
3. *The Minor portion of the Fifth.*
4. *The Facial, distributed to*
   1. *The Orbicularis.*
   2. *The Levator Alæ Nasi.*
5. *The Pneumogastric or its Accessory.*
   1. *The Pharyngeal.*
   2. *The Œsophageal and Cardiac*
   3. *The Laryngeal.*
   4. *The Bronchial, &c.*
6. *The Myo-glossal.*
7. *The Spinal Accessory.*
8. *The Spinal, distributed to the*
   1. *Diaphragm, and to*
   2. *The Intercostal and* } *Muscles.*
   3. *The Abdominal* }
9. *The Sacral, distributed to*
   1. *The Sphincters.*
   2. *The Expulsors, the Ejaculators, the Fallopian Tubes, the Uterus, &c.*

1119. I may here add the remark, that the presence of the reflex actions coincides with that of augmented irritability of the muscular fibre, described in my former Memoir, whilst their absence coincides with the diminution or annihilation of the muscular power.

1120. Such being the principles which regulate the presence or absence of the reflex phenomena in disease, I shall now proceed to make some observations on the diseases themselves, in which these phenomena are displayed, and to give

a series of cases in illustration, in the same sketchy manner as in my former Memoir.

I. *Of Diseases of the Head.*

1121. In the coma of apoplexy, of epilepsy, and of hydrocephalus, we observe, according to the *degree* of the affection, the diminution of the cerebral, and of the cerebral and true spinal functions. The test is supplied by the eye-lids. In the slighter forms of coma, the eye-lids are frequently but partially closed, yet they close perfectly on touching the eye-lashes. In the severer forms of this affection, not only the cerebrum, but the medulla oblongata, has its powers impaired, and the eye-lids do not close, although touched.

1122. *Case* 1.—I carefully watched the progress of hydrocephaloid symptoms in the case of a little boy aged four. The eye-lids closed imperfectly when he was undisturbed, but quite perfectly when the eye-lashes were touched with a pencil. This phenomenon ceased as the symptoms became aggravated, and returned as they were again mitigated.

1123. *Case* 2.—I visited a patient affected with the deep stupor left by a violent epileptic attack. I dashed cold water in his face without inducing inspiration: I touched the eye-lid without inducing its closure; a little water poured into the mouth excited cough, and was swallowed with difficulty: twenty ounces of blood were drawn from the arm, and the same experiments were made as before; the patient sobbed when cold water was thrown upon his face; the eye-lids closed on irritating their border, and deglutition was comparatively easy.

1124. The condition of the larynx, of the pharynx, of the respiration, of the sphincters, is similarly affected; and it may be remarked, in general, in regard to cerebral diseases, that they are less or more aggravated, according as the cerebral functions only, or the true spinal functions also, are affected. Impaired deglutition and respiration are, therefore, symptoms of the most serious import in cerebral diseases.

II. *Of Hemiplegia.*

1125. The reflex actions are not less observed in cases of hemiplegia than in cases of paraplegia; but as they are, in

general, more obvious the more complete the paralysis, and as the paralysis of hemiplegia is, in general, less complete than that of paraplegia, they have been less observed in the former affections.

1126. *Case* 3.—In one case of hemiplegia, so nearly complete that the patient could only move the toe very slightly, forcible retractions of the foot and leg were produced by tickling the sole of the foot, or by applying a spoon, just taken out of hot or cold water, to the leg.

1127. *Case* 4.—In a case of hemiplegia, occurring in a child five years old, in which voluntary motion was entirely lost, sensation remaining, the following phenomena were noticed by Mr. Barlow:—"When the paralytic arm or leg was pinched, it was convulsively retracted; and, on the sole of the foot being tickled, the leg was bent with much energy, and at the same time the upper extremity of the hemiplegic side was thrown into spasmodic action. The application of heat and cold alike produced reflex actions. The hand was immersed in water at the temperature of 90°, 120°, and 140°. In the first case, no muscular movement was perceived; in the second there were forcible spasmodic actions; in the last instance they were still more violent.

1128. "Dashing cold water on the face or chest occasioned convulsive movements of the paralytic limbs. Nothing could be more marked and evident than the effect of emotion upon the paralysed extremities. On exposing the chest, and dipping my hand into water, for the purpose of sprinkling some drops upon the skin, the child, inferring my intention from what had happened previously, cried violently, and at this time there were movements of the arm and leg, similar to those which were excited by heat, cold, &c. The half of the body in which the power of the will was unimpaired, participated not in these actions, even when they were most violent."

1129. I have already noticed the occurrence of reflex actions in hemiplegia (see the case given in my former Memoir, § 1068, Med. Chir. Trans. vol. xxii, p. 211), and in a case of hemiplegic loss of power of the hand, after severe attacks of epilepsy, of which I insert a brief outline here:

1130. *Case* 5.—W. W. aged twenty-one, had suffered a

degree of loss of power of the left arm and leg, from repeated and protracted epileptic seizures; he could not close the left hand firmly otherwise, but immediately grasped any object placed in the palm, with considerable force.

1131. *Case* 6.—An interesting example of reflex actions in hemiplegia is given by Dr. Baly, in his translation of Professor Müller's Physiology, vol. i, p. 721, note:

1132. Dr. Baly observes, "The translator has now under his care, at the St. Pancras Infirmary, a woman, aged fifty-three years, recently attacked with hemiplegia (complete loss of sensation and motion in the left upper and lower extremity), in whom, nevertheless, pinching or even slightly touching the sole of the foot or ancle of the paralysed leg, caused the limb to be retracted and the toes extended, the patient being unconscious both of the stimulus and of the movement. The phenomenon is here the more striking, as, in the opposite leg, which possesses its full voluntary power, no spasmodic contraction is produced, although the slightest touch is felt."

1133. *Case* 7.—Another interesting fact of the same kind is given by Dr. Holland, in his elegant "Medical Notes and Reflections," p. 324, note. "At this time," says Dr. Holland, "I am attending a patient who is scarcely able to raise his right arm to his chin, in effect of a hemiplegic attack three years ago; but in whom the dressing of a seton, near the lumbar vertebræ on the same side, often twitches the arm so forcibly as to raise it to a much higher level. In the same patient, when yawning, the fingers of the right hand become suddenly extended, though at other times bent closely and tightly inwards, without any power of opening them by voluntary effort*."

1134. In cases of hemiplegia, the paralytic arm has been agitated in passing the urine or fæces.

1135. *Case* 8.—Mr. F. aged about fifty-five, was seized, three months ago, with apoplectic symptoms, which left pretty

* It would be ungrateful in me not to express my obligations to Dr. Holland for the kind manner in which he has spoken of my labours in his excellent work just quoted (see pp. 149, 323, 602, 606). I am not less indebted to Professor Sharpey, for the equally kind manner in which he has spoken of these investigations, in his Lectures at University College. To these distinguished names, I have now the gratification of adding that of Dr. Watson. (See the Medical Gazette for February 1841, p. 739.)

complete hemiplegia. At first there were a little stertor and a little dysphagia; but these symptoms ceased with the apoplectic state, the former at once, the latter a little more tardily. There was also slight enuresis for several days. On tickling the sole of the foot, or pinching the skin, or pulling a hair of the leg, and on applying a spoon just taken out of hot or cold water, there were distinct sudden movements of the leg. The same thing occurred in regard to the arm, but in a less marked degree. On first applying galvanism, the paralytic arm was least affected; the effect, I suppose, of the shock of the disease: afterwards the paralytic arm was most moved, as in other similar cases. On the same principle, the effect of emotion, as laughter, was at the first more observed on the healthy than on the paralytic side of the face; more remotely, the equilibrium of the countenance, under the influence of laughter, was restored, or nearly so. At this time, the arm, and especially the hand, are paralysed to voluntary motion, but readily agitated by emotion, and sudden or energetic respiratory efforts, and constantly contracted, as by a spring, the arm towards the trunk of the body, the fingers towards the palm of the hand; and, lastly, more agitated by the influence of galvanism than the unaffected limb. The voluntary power of the arm is much less restored than that of the leg, in which the phenomena just enumerated are, comparatively, absent.

1136. Sensation is far less affected than the power of voluntary motion.

1137. The influence of certain acts of respiration, of emotion, of the principle of tone, &c. on hemiplegic limbs, though belonging to the spinal system generally, does not belong to the reflex actions, the more immediate object of this Memoir. Briefly adverting to observations made in my former Memoir (Med. Chir. Trans. vol. xxii, pp. 207-208, 210-11), (§ 1042 —,) therefore, I shall proceed to notice the case

III. *Of Paraplegia.*

1138. Under this head I shall very briefly adduce the various cases of reflex action which have been published, in the order in which they appeared. The phenomenon is now become familiar to every observer.

1139. I believe the first observation of this kind was made by Dr. Macartney, of Dublin, and it was communicated by him to Sir Benjamin Brodie, and by this latter gentleman to this Society. To Dr. Macartney I am indebted for the following note:

"My dear Sir,

"In reply to your letter, I have to say, that Sir Benjamin Brodie very accurately stated the fact as I had communicated it to him, respecting the priapism which is so apt to be induced by injuries of the spinal marrow. In the case to which he alluded, the man injured the spine by falling into a quarry. The erection of the penis was very violent immediately after the accident, and occurred at intervals for several weeks afterwards, especially on the slightest friction of the glans penis, so as to create much inconvenience in the introduction of the catheter. He had no consciousness of what was going on, unless he put his hand to the part, or looked at it.

"I have seen similar cases of erections after injury to the spinal marrow, but not in so extreme a degree; and I have observed a violent priapism in two men who were suffering death by hanging.

"I am very truly yours,

"J. MACARTNEY.

"Upper Merrion Street, Dublin,
"March 29, 1838.
"*To Dr. Marshall Hall.*"

1140. Sir B. Brodie has confirmed this remark by his own observation. He observes, "Priapism occurs even where the sensibility is entirely destroyed, and may be induced by the mechanical irritation caused by the introduction of the catheter, where the patient is entirely unconscious of the operation. This circumstance was pointed out to me, many years ago, by Professor Macartney, of Trinity College, Dublin; and I have had many opportunities of verifying the correctness of the observation*."

1141. The next observation of this kind is by Mr. Mayo, who has observed, in his Outlines of Pathology, 1835, p. 154, "In some cases of privation of sense and motion in the legs,

* Med. Chir. Trans. vol. xx, for 1836, p. 140.

through disease affecting the middle of the spinal cord, I have seen so much independent power remain in them, that pricking or tickling the foot, which yet excited no sensation, and was unknown to the patient, was nevertheless followed by its retraction."

1142. I believe we possessed no published facts of this kind before the attention of the profession was excited to them by my first publication on the subject of the Reflex Function of the Spinal Marrow, in 1832. Since that time, however, they have accumulated.

1143. Mr. Barlow and Dr. W. Budd each communicated to me a case of reflex actions in paraplegia, about the same time, in 1836. I was indebted for a third to Dr. Elliot of Carlisle; a fourth I visited by the invitation of Mr. Liston, at University College Hospital, and a fifth on board the Dreadnought, with Mr. Busk. I have since seen a considerable number.

1144. Mr. Barlow's case is the first observed and published with a view of illustrating my investigations into the nervous system; and, as it is at the same time the most complete, I shall give it in his own words:

1145. *Case* 9.—"John Bright, aged nineteen, on the first of October climbed up a walnut-tree, for the purpose of picking the fruit, and, when he had attained a very considerable height, slipped, and was precipitated to the ground. He was soon afterwards found, in a cold and pulseless condition, with his lower extremities numb and motionless. These symptoms at first naturally led to the supposition that there was a fracture of the spine; but examination gave no proof of it, and afforded no evidence of displacement: there was, however, a slight swelling in the situation of the two or three first dorsal vertebræ, and pressure there was attended by pain. He was much depressed by the violence of the shock, and his articulation was faint and indistinct. A few hours after, he had rallied, and complained of pain in his head, and giddiness, which were relieved by moderate depletion. There was obstinate costiveness of the bowels, which was overcome by strong purgatives; and retention of urine, which required the introduction of the catheter; and it was necessary to repeat this operation, at proper times, for

a month after the accident; subsequently to which, the bladder became incapable of retaining its contents. Although every attention has been paid him, sloughs have formed in the integuments of the back.

1146. " The following is the present state of the patient, three months after the accident:—The lower half of his body and inferior extremities are entirely *devoid of sensation*, and they are *not* in the slightest degree *under the influence of* the will: sometimes the patient has cold shiverings; and whilst the muscles of that part of the body supplied with nervous energy from above the seat of injury are observed to shake, those deriving their nerves from below that spot are perfectly motionless. This has been often remarked by his mother, who waits upon him.

1147. " Notwithstanding the anæsthesia, and the patient's inability to effect a single movement through the medium of volition, when the integuments of the legs are *pinched*, or more particularly when the sole of the foot is *tickled*, the extremities are retracted with considerable force. A little *cold water* dashed upon the surface has the same effect, though there is no feeling of coldness. The leg is constantly in the flexed position; and if straightened, recovers it again. When the *catheter* is introduced, the penis is excited into a state of complete erection, and this is invariably consequent upon the gliding the instrument along the urethra: at the same time the legs are drawn up, and a twitching of their muscles is very obvious.

1148. " That the muscular contractions, so easily excited by various stimuli, are referable to the reflex function of the medulla spinalis, cannot but be admitted. In this case, all communication between the *brain* and that part of the cord from which the lower half of the frame derives its nervous power, is, so far as function is concerned, effectually cut off; therefore, to the agency of the *spinal marrow* are owing those movements of which the mind knows nothing, and which, at first sight, *seem* to denote the perception of an irritating cause, and the wish to avoid it; though, upon inquiry, it is found that no sensation whatever exists.

1149. " The situation of the different portions of the fractured bones, and the condition of the spinal marrow within,

observed on a post-mortem examination, show that the influence of the cerebrum must have been separated from the parts below the injury. The spinal marrow was nearly severed in the neck." See *Plate* VIII, *fig.* 7.

1150. Dr. W. Budd's case is already published at length in the Society's Transactions, vol. xxii, p. 154, and need not, therefore, be reproduced here.

1151. *Case* 10.—In the order of time, Dr. Carpenter's case must next be noticed. It was published in the Edinburgh Medical and Surgical Journal, No. 132. It was observed by Mr. Madden. Mr. Madden says,—" In the Autumn of 1834, I was in attendance upon a case of complete paraplegia, in which it was necessary to employ the catheter twice daily. On several occasions, when the point of the instrument was passing the prostatic portion of the canal, where a slight obstruction existed, I observed that the patient jerked his legs violently; but, upon inquiry, he positively denied having experienced any sensation, being not even conscious of the presence of the instrument in the urethra. The disease appeared to have been originally induced by two severe injuries received a twelvemonth before. Upon dissection, the spinal cord, in the lower part of the dorsal region, was found completely disorganized, being converted into a semi-fluid pulp. The preparation has been placed in the museum of the College of Surgeons."

1152. Dr. Elliott's case is of great interest. It was one of spinal curvature, with a fluctuating swelling in the region from the fourth to the seventh *dorsal* vertebræ, with *paraplegia* and *rigid flexure* of the lower limbs.

1153. The loss of sensation and of voluntary motion was complete, but " powerful involuntary movements were produced in various ways."

1154. I am indebted to Dr. Elliott for the following interesting account of it.

1155. *Case* 11.—" There appeared to be no *sensation* from a little above the crest of both ilia downwards, on pinching, rubbing, or scratching with a pin. Friction with the hand over those parts of the *abdomen* devoid of sensation, and over the ilium, on the right side, produced, when the girl lay on the left side, powerful *extension* of the right leg and thigh, *i. e.*

the limb, if previously bent, became straight, and was forcibly moved backwards. Friction over the *sacrum* caused instant *flexion* of the knee and thigh; friction of the corresponding surfaces on the left side produced very irregular motions of the left lower limb."

1156. An interesting case was communicated by Mr. Barron to Mr. Grainger, and published in the latter gentleman's work "On the spinal Cord," (p. 94).

1157. *Case* 12.—"A girl about fifteen years of age, who was a patient of Mr. Crosse, at the Norfolk and Norwich Hospital, a few years since, was affected with angular curvature of the spine, producing insensibility and paralysis of the lower extremities. On tickling the *soles of her feet,* which as an experiment was often done, the legs were immediately slightly retracted, although the patient said she felt nothing; it was further remarked that on touching the *other parts of the feet* or *the legs,* in the same manner, no effect was produced."

1158. I am indebted for the following case to C. Slee, Esq. of Middlesbro', Yorkshire.

1159. *Case* 13.—"John Alderson, aged twelve, is a most intelligent boy, of strumous habit. About six months ago a tumor was observed *between the scapulæ,* and a short time afterwards he became unable to walk without falling, even on a level floor. Soon after this he ceased to have the power of lifting his feet from the ground, when in the sitting posture. On pinching the feet and legs, I was astonished to find that each attempt caused violent involuntary startings of the limb, which were very painful. The sense of touch appeared to me to be even more acute than natural in every part of the lower extremities. I was informed that a current of cool air, on coming in contact with the limbs, frequently gave rise to the same phenomenon as that caused by pinching."

1160. *Case* 14.—In a case read by Mr. Obré, before the Royal Medical and Chirurgical Society, on March 17, 1840, of hemiplegia from tumor in the pons varolii, in a boy nine years of age, both the paralytic limbs, but especially the leg, were much agitated, and priapism excited by passing the catheter.

1161. But I need not occupy the attention of the Society by any further detail of cases of this kind, especially as I have

it in my power to remind them of the admirable and invaluable "Contributions to the Pathology of the Spinal Cord," published in the last volume of its Transactions, by Dr. William Budd.

IV. *Tetanus; Hydrophobia; Effects of Strychnine.*

1162. As in cerebral paralysis we have augmented irritability of the muscular fibre, or of the *vis insita*, in tetanus and hydrophobia we have the *vis nervosa* morbidly augmented, but in an infinitely greater degree.

1163. The slightest external stimulus is sufficient to excite reflex actions in their most terrific forms.

1164. What is remarkable is, that it is precisely the functions of the orifices and sphincters, of the ingestors and egestors, which are most affected in these formidable diseases; and, most of all, the larynx, the pharynx, the organs of respiration, and the rectum.

1165. The remarks which have been made relative to the condition of the reflex function in tetanus and hydrophobia, apply equally to that artificial tetanus induced by strychnine. In a report of La Charité, of Berlin, drawn up by Dr. Köhler, it is observed that "in some individuals, the sensibility to external impressions, under the influence of strychnine, was so great, that they broke out into an almost uncontrollable fit of laughter on being touched with the finger."*

V. *Undue Paraplegic Excitability.*

1166. Instead of paraplegia, and the other forms of paralysis, arising from disease of the spinal marrow, we have occasionally undue excitability. I think this subject has not been sufficiently treated of in medical writings. But I can only briefly notice it here in connection with the main subject of this paper. On another occasion, I may beg the attention of this Society to it more particularly. It is still a question how far the spinal marrow is primarily or organically affected in these cases; which I think quite distinct from those of common paraplegia.

1167. *Case* 15.—In one interesting case (which was once seen by our President), there were movements of the fingers

* Lancet for October 1836.

somewhat like those seen in chorea, whilst the muscles of the legs were spasmodically contracted; the patient was as incapacitated for muscular exertion as in paraplegia. The point to which I wish particularly to allude here is this,—the skin was so susceptible to impressions in certain parts of the surface, that the patient was affected with a sort of general emprosthotonic spasm, with a slight sob whenever the bedclothes, for instance, were drawn over his chest, and still more especially when the penis was accidentally touched in a similar manner. Similar effects were observed on applying the pure potassa to establish an issue along the spine. The legs were drawn upwards whenever the sole of the foot first touched the cold floor on rising in the morning.

1168. This affection has appeared to arise—"a venere nimiâ, et præsertim solitariâ."

1169. In another case, in which there was a peculiar dysphagia, which I shall proceed to describe more particularly, together with inability to use the lower limbs, the susceptibility of the skin was such, that the touch of the left side of the thorax by a coarse towel produced the most painful and intolerable "*shudder*."

VI. *Peculiar Dysphagia.*

1170. I have met with three cases of the peculiar form of dysphagia to which I have just alluded. From an undue excito-motory action, the pharynx seizes some solid portion of what is attempted to be swallowed, and this is afterwards returned by a peculiar effort, for which I know of no designation but that of a forcible hawking. A pill, though taken with a large draught of water, is arrested at the upper part of the pharynx. A little of the core of apple, or of the gristle of meat, is seized and retained in the same manner, the rest being duly swallowed. Sometimes, large portions of food are thus retained. When the pharynx is thus occupied by a portion of food, it is necessary to remove it either by swallowing some fluid, or by the effort just described. It may not be without interest to add, that I am myself affected with this singular kind of dysphagia.

VII. *Morbid Action of the Rectum and Bladder, and of the Sphincters.*

1171. There is a peculiar affection of the rectum and bladder in some nervous affections, of which the following experiment affords both the type and illustration: if, in a turtle, after the removal of the tail and the posterior extremities, with the rectum, and, of course, with a portion of the spinal marrow, water be forced into the intestine by means of Read's syringe, both the cloaca and the bladder are fully distended before any part of the fluid escapes through the sphincter; which it *then* does only on the use of much force, and *by jerks*. If, when the cloaca is distended, the integuments *over it* are stimulated, the water is propelled to a considerable distance.

1172. When the rectum or bladder is distended, the patient feels a sudden call, and the action of the expulsors is so energetic, or the power of the sphincters is so diminished, that, unless the call can be promptly obeyed, the fæces or urine escapes. See further, the close of § 1192.

1173. In tenesmus and strangury, the sphincter of the rectum and of the bladder is excited to undue contraction respectively. A ligature applied to hæmorrhoïds not uncommonly induces spasmodic action of the cervix vesicæ and retention of urine. In one case, calculus in the bulb of the urethra induced spasmodic stricture of the sphincter ani. All examples of morbid reflex action.

VIII. *Singular Action of the Thoracic and Abdominal Muscles.*

1174. *Case* 16.—In an interesting case, it was observed that, whenever the rectum was more than usually fretted, the muscles of the thorax and abdomen were drawn into violent action, especially the serrati and the recti; the insertions of the former, and the divisions of the latter, were marked as we observe them in certain pictures and statues.

1175. I now beg to draw the attention of this Society to another subject,—the localization of the effects of certain remedies, if I may use this expression:

The Localization of Remedies.

1176. The localization of certain remedies is highly worthy of observation: strychnine acts upon the glottis, cantharides on the neck of the bladder, aloes on the rectum, the secale cornutum on the uterus,—all organs specially under the influence of the excito-motory power and reflex function of the spinal marrow.

1177. I shall illustrate this subject, as before, by briefly adducing the particulars of two most interesting cases.

1178. *Case* 17.—*Strychnine.*—A lady, aged 35, being at Lausanne, in September 1836, consulted a foreign physician there, who prescribed the strychnine; I do not know the dose; I only know that it was afterwards *diminished* to one-tenth of a grain thrice a-day. Two pills were taken at bed-time, and three the next morning; soon after which, the patient was taken with spasm of the muscles about the larynx, and those of one arm. She felt as if strangled. With much effort she mixed some *eau de Cologne* with water, "snapped at it," and so swallowed it. She was shortly relieved. The dose of strychnine was repeated between breakfast and noon. The same symptoms were renewed; she *felt* and *looked* as if strangled. The muscles on each side of the larynx became tense, like cords; she was again relieved by *eau de Cologne*, which she took hastily, as before. After this, the dose of strychnine was reduced, as I have stated, and was taken without any bad effect. *Tracheotomy* would be the proper remedy in extreme necessity. See § 900, &c.

1179. For the following interesting case I am indebted to Mr. Robarts, of Everett Street, Russell Square.

1180. *Case* 18.—*Cantharides.*—A young lady, aged twenty-seven, had a fatty tumor within the tenth and eleventh dorsal vertebræ; it gradually, but completely, severed the spinal marrow, and induced perfect paraplegia. The bladder lost its power of retention. The singular fact in this case was the following: On giving a dose of tincture of cantharides, the power of retaining the urine was always restored *for the time.* This power would cease, and again be restored, on suspending or repeating the medicine.

1181. It is obvious that the cantharides acted through the

segment of the excito-motory system, left below the division of the spinal marrow.

1182. What strychnine effects in regard to the larynx and pharynx, cantharides effect in regard to the cervix vesicæ: the reflex function of these parts is augmented, and stimuli, which have no such effect naturally, induce morbid and even spasmodic actions. I need not illustrate the special and local action of aloes, or of the ergot, by any cases.

1183. On the other hand, certain localities are more susceptible than others to the effects of the excito-motory stimulus: the sole of the foot is especially one of these; Dr. Little has published in his Thesis an interesting case of distortion of the foot, which only, but uniformly, occurred when it was placed upon the ground:

1184. *Case* 19. "Juvenis quidam si planta pedis humum attingebat, spasmo tonico gastrocnemiorum afficiebatur, quo calx sursum trahebatur. Sin æger sellâ sedebat vel supinus jacebat, pedem naturali modo undique movere et gastrocnemiis prorsus imperare potuit. Quoties vero digitis humum tangebat, ut infra fusius retulero, gastrocnemii spasmodice contrahebantur." Dr. Dieffenbach met with a similar case.

1185. The sides of the thorax are most susceptible to the singular effects of tickling, and to the augmented susceptibility or excitability of which I have briefly sketched two cases.

1186. Having thus illustrated the subject of the morbid reflex actions, I must proceed to another object of this paper, viz. to point out the comparative effects of the different excitants of the reflex function.

The Excitants of the Reflex Actions.

1187. The fœtus in utero is so little exposed to the influence of stimulants or excitants applied to the cutaneous or mucous surfaces, that the excito-motory property is *comparatively* little called into action in the form of the reflex function. The contact of the liquor amnii may preserve the lips or the larynx, and the sphincter ani, closed. In this manner, the reflex function or the function of exclusion and of retention is in activity; but, as the agent in ingestion and egestion, it is as if it did not exist.

1188. It is on the expulsion of the fœtus, and by the contact of the atmospheric air with the minute origins of the incident nerves of the excito-motory system, that the functions of ingestion and egestion first commence.

1189. It is, doubtless, from the impression of the atmospheric air on the trifacial and spinal nerves, distributed upon the surface of the face and body, that the first inspiration is excited. My friend, Dr. Heming, in attendance on a case of labour, waited, after the delivery of the child, for the usual sign of respiration, viz. crying. This did not take place; and Dr. Heming began to feel a little anxiety for the infant's safety. On the point of proceeding to the use of some means of resuscitation, he raised the bed-clothes, and of course admitted the atmospheric air into contact with the infant's skin. Inspiration was instantly excited, and the little patient continued to breathe.

1190. The influence of cold water dashed on the face, and the influence of the diffused contact of the cold bath, in exciting sudden sobbing acts of inspiration, are well known.

1191. The same contact of cold air which excites the first inspiration, also excites the first acts of suction and of expulsion of the fæces and urine. This effect is also seen in the later periods of existence. The cold bath induces the same effect. I have observed animals, on being driven through a cold stream, invariably to evacuate the rectum and bladder. Cold water, injected into the rectum, is sometimes expelled with force. The same effect was produced in one of Dr. William Budd's patients*, on injecting cold water into the bladder. Might not this remedy be used with advantage, internally as well as externally, in lingering labour and uterine hemorrhage?

1192. For not only the bladder and rectum, but the uterus is subjected to the same influence. The catamenia are apt to be suddenly checked by the influence of cold. The uterus is excited to contraction, and uterine hemorrhage is most distinctly arrested by an effectual douche of cold water.

1193. I may here advert to the *diffused* influence of a mere *partial* application of cold upon the skin. The pores over an extensive surface are closed, and the perspiration

* Medico-Chirurgical Transactions, vol. xxii, p. 182.

arrested. Is this a *muscular* phenomenon, belonging to the reflex excito-motory system?

1194. It is interesting to observe the salutary effects of a new exposure of a fœtus at the precise moment when new functions are required. It is also interesting to observe the influence of the same cause at subsequent periods of life, and in certain cases of morbid affection. Of the latter, none are more remarkable than the phenomena observed in the coma of epilepsy and apoplexy. The medulla oblongata being compressed, together with the other contents of the cranium, the influence of dashing cold water on the face may be absolutely null: on taking off that pressure by blood-letting, the susceptibility to the influence is again restored: it becomes a measure even of the diminished compression.

1195. There are other influences of cold, which must not be passed over unnoticed. Free exposure of the face to the cold breeze is the most effectual remedy in sickness, and affords manifest relief in asthma.

1196. As to other excitants of the reflex functions, we need only call to mind the simplest facts. The nipple or the finger, introduced between the lips of the new-born, or even the anencephalous, fœtus, immediately excites the act of sucking: the mere introduction of the enema pipe into the rectum of an infant equally excites the action of the rectum. The irritation of a few grains of common salt, applied to the border of the sphincter ani, will induce the premature expulsion of an egg in a common fowl*.

1197. I need scarcely allude to food as the natural excitor of the pharynx, œsophagus, and cardia, or to the fæces and urine, as the equally natural excitors of the expulsors about the rectum, and of the bladder.

1198. It will be observed that in *all* these cases the excitant is applied to *cutaneous* or *mucous* surfaces: these surfaces are, indeed, the only surfaces exposed to the action of external stimuli: some internal textures are, however, capable of transmitting the influence of excitants. I have seen the limbs of the decapitated turtle moved energetically on dividing internal tissues; and I have known spasmodic affec-

* The same effect is said to have been produced by the secale cornutum, in an experiment performed by M. Velpeau.

tions induced by disease of similar internal tissues; of which the cases published in the Transactions of this Society, in its twenty-second volume, p. 1, by Dr. R. Bright, may be examples.

1199. It still remains for us to trace the influence of excitants of this function in some more hidden cases. It is almost certain that the gall-ducts, the ureters, and other excretory canals, are endowed both with incident and excitant, and with reflex and motor, nerves. The passage of a biliary or urinary calculus *excites* vomiting: exposure to cold, a loaded intestine, certain passions, and in infants mere dentition, will, on the other hand, arrest the flow of bile and induce icterus. See *Plate* VI, *fig.* 2.

1200. The influence of the excitants of this system of actions, considered as *remedies*, is little known. The free exposure of the face to the cold breeze diminishes sickness and vomiting, and relieves asthma. One of the most interesting examples of this kind is that of the application of cold to the face and to the general surface, in some cases of suspended animation. As a remedy in the cases of the still-born fœtus and of drowning, the sudden contact of cold water is most important. I have already alluded to the use and influence of the cold water douche in cases of hemorrhage from inaction of the uterus.

1201. Physiology is still in need of a series of experiments upon the comparative influence of the several excitants, especially cold, heat, and *mechanical irritation*.

1202. It only remains for me to observe here what are the agents which most effectually excite the reflex actions in disease, and especially in the cases of cerebral paralysis. A metallic spoon, taken out of cold or hot water, and suddenly applied, the pulling of a hair, the prick of a needle, the titillation of a feather, are the means which most naturally suggest themselves as tests of the excito-motory actions in cases of paraplegia.

1203. The subject of tickling ought to be treated more at length, but I refrain from doing so for fear of wearying the attention of the Society.

1204. To this account of the *Excitants* of the reflex actions, I must add a few observations on

The Influence of Shock.

1205. In Dr. W. Phillip's experiments it was found, that although the brain and spinal marrow might be gently removed, without immediately affecting the action of the heart, yet that neither of these organs could be *crushed* without immediately diminishing that action.

1206. In one case of hemiplegia, I found the muscles of the paralytic limbs less irritable soon after the attack, than those of the healthy side; afterwards, they became more irritable, according to the general law laid down in my first Memoir*. The horse or the ox struck with the poll-axe falls instantly; the spinal marrow is then destroyed; but if not, the animal has been known, after the lapse of a little time, to rise and regain its position.

1207. It has been observed, both in experiment and in disease, that the reflex actions are not manifested immediately after an injury of the spinal marrow, but that they become gradually established more remotely†. Is the *irritability* diminished at this moment, tested by galvanism? or is it the *vis nervosa*, when this is so affected?

1208. In a series of experiments performed upon the connexion of the nervous system with the circulation, I found that, after the total removal of the brain and spinal marrow in frogs, the capillary circulation continued in the web during thirty-six hours; but that it was instantly arrested by crushing the other limb‡. This effect could only be produced through the ganglionic system.

1209. In Dr. J. Reid's experiments, the same effect was produced by repeatedly galvanizing the muscle.

1210. The effects of a violent accident upon the human frame are well known, and must be explained upon similar principles,—principles not yet fully understood.

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* See Medico-Chirurgical Transactions, vol. xxii, and above, p 205.

† See Dr. W. Budd's Paper in Med.-Chir. Trans. vol. xxii.

‡ Essay on the Circulation, 1831, and above, p. 127—129.

II. *Retrograde Action in Spinal Disease.*

1211. The subject to which I now venture to call the attention of the Society is involved in the deepest obscurity.

1212. It has been observed in certain experiments, which I shall detail very briefly, that an irritation of the middle part of the spinal marrow, below the origin of the brachial plexus, induces in some decapitated animals, and especially the cold-blooded and the very young of the warm-blooded, distinct movements of the anterior extremities.

1213. I removed the head of a young turtle: on pinching and galvanizing the lower extremity of the medulla oblongata, there was an excited act of inspiration. The same event occurred on stimulating the nostril, the intra-maxillary or palatine fringes, and the internal part of the larynx.

1214. I then laid bare the middle portion of the spinal marrow by removing part of the shell. On pinching or galvanizing this, *both* the *anterior* and *posterior* fins were moved.

1215. I took a frog, separated the head, and divided the spinal marrow low in the back: I then stimulated the lower end of the upper portion of the spinal marrow with the forceps; the anterior extremities moved in the most remarkable manner:—they were gently raised, without being affected with the *twitchings* seen in the inferior extremities when the upper part of the lower half of the divided spinal marrow was stimulated.

1216. I was next anxious to perform these experiments on an animal of warm blood. I chose for this purpose a rabbit of six days old. I first removed the head. I then stimulated the lower end of the divided medulla. There was an immediate act of *gasping*. I then divided the spine in the back, and stimulated the lower end of this middle portion of the spinal marrow; the anterior extremities were immediately moved.

1217. In reference to the question, whether retrograde actions of the spinal marrow take place in disease, that is, whether spasmodic or other morbid action occurs in disease of the spinal marrow *above* the seat of the disease,—I must content myself with brief extracts from the "Memoirs" of M. Louis, and one or two English works.

1218. In Mr. Copland's "Observations on diseased Spine," published in 1815, p. 47—50, there is a case in which disease seated in the lower part of the dorsal region affected the upper extremities.

1219. This case is mentioned and confirmed by Sir B. Brodie in the *first* edition of his "Observations on Diseases of the Joints," in 1818; but the subject is omitted in the *third* edition of that work, in 1834; from which we may conclude that the author had subsequently learnt to doubt the accuracy of the observation.

1220. In the "Mémoires sur plusieurs Maladies" of M. Louis, I find the following interesting observation, in relation to a case of caries of the *third and fourth dorsal* vertebræ;— "Les bras, déjà faibles dès l'entrée de la malade à l'hôpital, furent comme paralysés dans les trois derniers mois qu'elle y resta; ses mains étaient constamment *fléchies*, mais ses avant-bras jouissaient de quelques mouvemens: elle éprouvait des douleurs aux épaules, aux coudes et aux poignets; elle en eut de très vives dans les deux derniers mois aux épaules, et peu après son arrivée à Saint-Germain, la tête s'inclina du côté gauche, et garda constamment depuis, la même position. L'appétit avait peu diminué, les selles avaient été plus rares que fréquentes, et dans les quinze jours qui précédèrent l'entrée de la malade à la Charité l'émission de l'urine fut difficile.

1221. "Le 13 Novembre, tête inclinée à gauche, figure assez animée; paralysie des bras; douleurs dans toute l'étendue des avant-bras, et jusqu' à l'extrémité des doigts, lancinantes, augmentées par le mouvement." p. 422.

1222. At p. 427, M. Louis adds, "Mais comme, dans les observations où règne le plus grand accord entre les symptômes et les causes auxquelles on doit les rapporter, il n'est pas toujours possible de se rendre compte de tout, nous ne chercherons pas à expliquer pourquoi, dans le cas dont il s'agit, la douleur de l'épine n'a eu lieu que dans les trois derniers mois de l'affection; ni comment le ramollissement de la mœlle existant au niveau des *troisième et quatrième* vertèbres dorsales, les *bras* étaient paralysés tandis que les avant-bras jouissaient de quelques mouvemens. Ces différens objets sont encore pour nous des anomalies; et resteront peut-être tels, fort longtemps."

1223. The only other observations which I shall adduce at present are taken from Mr. Stafford's work on the spine.

1224. *Case* 20.—"October 1831.—A man fell from the top of a waggon-load of hay; he had struck his back upon the *second, third,* and *fourth* lumbar vertebræ, which were considerably displaced laterally, the body leaning to the right side, leaving but little doubt that the spine at that part had suffered fracture. He was perfectly paralysed below the injury; the fæces escaped involuntarily, and the bladder could not expel its contents; the arms likewise were partially paralysed, in both the powers of feeling and motion. His present state is as follows:—the muscles of the right arm are so *contracted* that it is closely fixed to the side; the fore-arm, from the same cause, rests upon the humeral part; the wrist is bent on the fore-arm and the fingers are firmly clenched in the palm of the hand; the sense of feeling is partially lost; the left arm is affected in the same manner, but not in so great a degree; the right leg has both the power of motion and feeling; the left leg has the power of feeling, but not that of motion; the sphincter muscle of the rectum remains paralysed, the fæces still escaping involuntarily, and the bladder only expelling half its contents.

1225. "The various symptoms just related are certainly very extraordinary, and, had it not been for the discoveries of modern physiologists, they could not have been accounted for; and even as it is, some of them are still involved in great obscurity. For example, how can we explain why the parts *above* the place where the blow was received, should suffer as well as those *below?* Such phenomena cannot be satisfactorily accounted for, and the only attempt at elucidation we can offer is, that the origins of those nerves, or that particular part of the substance of the medulla with which they are connected, supplying the parts affected, have more particularly suffered."

1226. It is obvious that the question agitated in this place is one of great moment in the diagnosis of diseases of the spine; for if there be, in disease or accident, retrograde influences of the spinal marrow, we must not always conclude that the disease or injury is situated *above* the origin of the nerves affected.

It is equally obvious that the whole subject needs new and accurate observation.

1227. I trust that one advantage will arise from the brief remarks which have been made in this communication; viz. that, in every case of cerebral or spinal disease, and disease of the nerves in their course, the condition of the reflex actions, and of the retrograde influences of the spinal marrow and nerves, will henceforth be carefully examined. The first of these subjects has already made some progress; the second has scarcely been touched upon in medical writings. I will venture to suggest that cases of caries of the vertebræ appear to afford the most probable example of diseases *limited* to a given region of the spinal marrow, and therefore the best for the latter kind of inquiry. They afford examples of *irritation* before morbid processes have induced *disorganisation*. The questions to be considered are two. 1. Is there paralysis? 2. Is there spasmodic action? in parts receiving their nerves from portions of the spinal marrow *above* the seat of the disease.

1228. The time is already arrived when it is impossible to examine a case of cerebral or spinal disease without a distinct reference to the sentient and voluntary, and the excito-motory phenomena. The cases taken and recorded before this distinction was clearly pointed out, are already felt to be inadequate to fulfil the demands of observation. The subject must be resumed: observations must be made anew, with constant reference to the distinctions which I have established, before all the evidence which they afford can be said to be derived from them.

Inferences.

1229. I will conclude this paper by submitting to the Society the following propositions or inferences.

1230. 1. It is proved, by the series of facts which have been observed in the human subject, that the excito-motory reflex actions are independent of sensation and volition, however they may be accompanied by sensation, or influenced by volition, in the perfect animal.

1231. 2. It is proved, as a consequence, that the reflex actions are dependent on another principle of the nervous system;

and it is proved by a series of experiments, that this principle is the *vis nervosa* of Haller, acting according to a new reflex law.

1232. 3. The phenomena of the excito-motory reflex actions are obvious in cases of paralysis, in proportion as that paralysis is more complete; they are, therefore, more observable in paraplegia than in hemiplegia, in general, but in each of these according to their intensity; they are therefore not only independent of sensation and volition, but inversely as these, frequently disappearing as these return.

1233. 4. In accidents, as in experiments, the excited reflex actions are not immediately observed, but are manifested only after the lapse of certain intervals of time; it is plain, therefore, that the first influence of shock is to diminish the excito-motory power; and this may remain until the patient falls a prey to the accident; as in the case noticed by Dr. W. Budd*.

1234. 5. It is observed that at a subsequent period, in more favourable cases, the excito-motory power is not only restored to its normal condition, but morbidly augmented. This I have recently witnessed, in a remarkable degree, in experiments on the frog, many days after I had divided the spinal marrow.

1235. 6. This is especially observed in certain diseases, as tetanus, the effects of strychnine, &c.

1236. 7. The reflex arcs of the nervous system will be imperfect in cases of disease or injury of the lumbar or sacral regions, as in the case noticed in Dr. W. Budd's paper†, and the reflex actions will consequently be absent; a fact which affords, in its turn, an important source of diagnosis, as to the seat of the disease.

1237. 8. In certain cerebral affections attended by coma, the presence or absence of reflex actions, in the eye-lids especially, gives us an index of the degree of severity of the disease.

1238. 9. Certain diseases, as hydrophobia, epilepsy, hysteria, and certain remedies, as strychnine, cantharides, &c. not only induce augmented excitability, but manifest their effects pre-

* Medico-Chirurgical Transactions, vol. xxii, p. 185.
† Ibid.

cisely upon the organs which are, physiologically, under the influence and dominion of the excito-motory power.

1239. 10. There are new forms of disease of the true spinal functions, not hitherto described, such as the dysphagia, the peculiar action of the rectum, &c. which have been briefly noticed.

1240. 11. Certain parts, as the sides of the thorax, the soles of the feet, &c. are more susceptible of the excitement in question than others.

1241. 12. Dr. W. Budd has very justly observed, that in many cases of violent reflex, and even convulsive actions, there was no sense of fatigue, and little emaciation of the muscles. In fact, fatigue is a cerebral state, and cannot be expected to occur in the cases in which the reflex actions are most observed; and emaciation is most obvious in spinal paralysis, in which the reflex arcs being interrupted, the reflex actions are also precluded from taking place. Fatigue *is felt* severely after violent attacks of epilepsy and other spasmodic diseases, in which the cerebral functions are afterwards restored.

1242. I beg to observe, in conclusion, that, lengthy as this communication may appear, I have done my utmost to curtail it, and have omitted much that I should otherwise have inserted. On some future occasion, I trust I may be allowed to explain, more particularly than I could do on this, *the plan of observation of diseases of the nervous system* to which I have briefly adverted, p. 251. (§ 1230.) The importance of this view of the subject will be at once apparent, on reading the valuable works of M. Lallemand and M. Andral, whose cases, indeed, would be required to be observed anew, with a distinct reference to these recent views of the nervous system. Scarcely a case of cerebral or spinal disease occurs in which it is not necessary, at the bed-side, to advert to the distinctions which I have pointed out, in reference both to the diagnosis and treatment. Such is the *practical* application and value of this investigation.

1243. It is necessary to advert to another important topic —the influence of *emotion* in diseases of the nervous system. This I propose doing in a third Memoir.

Memoir III.—*On the distinct Influence of Volition, of Emotion, and of the Vis Nervosa.*

Read June 23rd, 1840.

1244. In my two former Memoirs, I have treated, firstly, of the condition of the muscular *irritability;* and, secondly, of the phenomena of the *reflex* and *retrograde* actions of the spinal marrow, in various diseases of the nervous system. In the present Memoir, which may be regarded as completing, for the present, the subject of the morbid actions of the muscular system, I propose to point out some other sources and phenomena of those actions.

1245. There are *three* causes or principles of muscular motion in the animal economy, besides the motor contractile power in the nervo-muscular fibre itself; viz. *volition, emotion,* and the direct and reflex actions of the *vis nervosa.* In order that the subject may be the more distinctly understood, I will, in the very first instance, adduce facts which will illustrate these several modes of action, excepting, however, the reflex, which forms the subject of Memoir II.

1246. *Volition* has a constant influence over some of the muscular actions, of which we are almost unconscious, and which we only discover by carefully observing the effects of its subtraction. The acts of respiration, originating, as they do, in the reflex function of the spinal marrow, are nevertheless regulated and rendered equable by this silent but constant influence and agency of volition. Let this influence be withdrawn, as it is greatly during sleep, and in the moments of great attention, and the respiration immediately becomes audible, suspirious, and irregular. I have particularly noticed the condition of the respiration during deep sleep, and during the intense application of the mathematician in his studies and of the engraver in the execution of the finer parts of his work, and I have uniformly observed the effect of this subtracted influence of volition. In coma, the same phenomena are still more remarkable, and the respiration becomes stertorous, variously irregular, and alternately suspended and sighing. The degree of this change marks the degree of the coma; but when the coma is deep, other causes are in-

volved besides the subtraction of volition; viz. an impaired condition of the reflex function itself, arising from counter-pressure on the medulla oblongata, a point which I propose to discuss hereafter.

1247. It is difficult to determine how far this regulating influence of volition is essential to life. The anencephalous human fœtus, in which the true spinal system is perfect, is, nevertheless, *not* viable; yet, in the experiments of M. Flourens, the common fowl lived for a considerable period after the removal of the cerebrum*. The effects of opium and other narcotics would doubtless prove fatal in many instances, if the patient were allowed to enjoy his overwhelming sleep, and were not constantly roused to continued acts of volition, with their attendant influence on the respiration. We keep the narcotized patient moving, that he may be kept breathing well. I need scarcely observe, that the position of the body, as well as every action of locomotion, involves the constant and the almost equally unconscious influence of volition. As the true rhythm of respiration is sustained by the constant agency of volition, so every act and every step are guided by the same power continually. In cases of anæsthesia, the patient cannot retain a cup between his fingers safely, unless he keep his eye steadily fixed upon the object and the grasp, so as to supply by vision the loss of the sense of touch, the usual and the essential prompter of the acts of volition†.

1248. But if volition has frequently a silent and unsuspected influence on the muscular movements, this is still more

* " J'enlevai les deux lobes cérébraux à la fois sur une belle et vigoureuse poule.

" Cette poule, privée de ses deux lobes, a vécu dix mois entiers dans la plus parfaite santé, et vivrait sûrement encore, si, au moment de mon retour à Paris, je n'avais été obligé de l'abandonner."—Du Système Nerveux, par P. Flourens, 1824, p. 87.

† The course and the flight of birds continue after decapitation, and, therefore, independently of volition, and, consequently, of *aim* or design. In such cases, flight depends on the *vis nervosa*, on the same principle, therefore, as the movements of respiration. In this manner we explain the circumstances of the long flight of the swallow, &c. in its migration, and the high flight of the lark during its love-song: excited by instinct and desire, these flights are *guided* by sense and volition; but they are sustained by a principle which, as in respiration, is incapable of fatigue. Our surprise at the immense flight of these birds is consequently greatly diminished. But this subject must not be pursued on the present occasion. See *particularly* § 981.

true, for obvious reasons, of *emotion*. This assertion will not appear unguarded when I recall to the mind of the members of this Society that the influence of emotion is the almost sole cause of *expression*, whether this be observed in the countenance, the hand, the respiration, or in the action of other parts of the muscular system. Man lives a life of emotion, and every passing thought, every care, desire, passion, is impressed as it were on the muscular system; violent emotions, as sudden and great surprise, induce spasm of the muscles, or the very contrary effect, as seen in the relaxation of the sphincters from fear. The internal organs equally feel the influence of emotion: the heart and some parts of the arterial system, the intestinal canal, &c. the cutaneous surface, the kidney, &c. are obviously amongst this number.

1249. Every day's observation convinces me that the effects of emotion, in inducing and complicating diseases of the nervous system, are greater than has hitherto been imagined. This is observed, as I shall presently have occasion to state, more particularly in chorea, tetanus, &c.

1250. In healthy circumstances the influence of emotion is contracted and frequently altogether counteracted by that of volition. But in circumstances in which this latter influence is withdrawn, that of the former becomes strongly manifested. Thus the agitation of Nelson's heroic mind could not have been seen in his countenance or actions, under ordinary circumstances, but the stump of his amputated arm, withdrawn from the habitual subjugation of volition, was violently agitated on many trying occasions of emotion; and I have seen similar effects in other instances. Thus, too, the hemiplegic arm, paralysed to volition, is moved and agitated by every emotion, such as surprise, and especially such as are connected with respiration, (and they are only connected with respiration and not really respiratory), as sighing, yawning, stretching, &c.

1251. Not only does emotion remain in connection with the hemiplegic limb when sensation and volition are severed from it, but that emotion exerts its influence precisely upon those muscular organs which are under the influence of the *vis nervosa*, or excito-motory power: viz. the orifices and sphincters, the agents of ingestion and egestion; and as the *vis nervosa* acts *directly* upon certain internal organs, as well as *reflectively*

upon those just mentioned, so we find the heart, the intestinal canal, the organs of secretion, &c. especially under the influence of emotion.

1252. There is a near connection between emotion and hysteria, which is doubtless very much a disease of emotion; the same organs, the same functions, are affected. Emotion affects the larynx, the pharynx, inducing a feeling of choking or of globus. I have known it induce dyspnœa, vomiting, jaundice, relaxation of the sphincters, palpitation, syncope; to blanch or flush the cheeks; to arrest the secretion of the saliva, of the bile, and singularly to augment that of the perspiration and of the urine.

1253. Sensation and volition thus are seated in the cerebrum and its prolongations; emotion in the true spinal and the ganglionic systems. It is this distinct view of the subject to which I wish to draw the attention of the physiologist and pathologist. It is in such a view that physiology and pathology meet and mutually illustrate each other.

1254. It is to be particularly noticed, that of certain impressions made on the senses, some appear to act on a principle similar to that of the emotions, whilst others act immediately on the vis nervosa. Of the former kind are the sight of objects which induce disgust, sickness and faintishness; certain odours, certain flavors: of the latter kind are tickling, &c. I have also known the attempt to untie a very small knot induce a feeling of sickness. What is the nature of this phenomenon*?

1255. Another form of muscular action, if not of motion, is that seen in the muscular system in general, and designated *tone;* the effect, I believe, of the constant agency of the *vis nervosa.* Far less obvious during the healthy condition of the system, it is made very manifest in certain circumstances of disease, and on the first cessation of the animal functions in death. When the influences of volition are withdrawn in hemiplegia, the hand and arm become much and permanently contracted. The influence of the same power is observed immediately after death, in the phenomenon termed cadaveric rigidity.

1256. In tetanus, and in some diseases of the spinal marrow

* There are some other facts sufficiently singular and not yet explained: what, for example, is the nature of the phenomenon of "setting the teeth on edge?"

and of the muscular nerves, we observe the effects of the augmented action of the *vis nervosa.*

1257. Let us now examine the effects of hemiplegia: the arm is perfectly paralysed to *volition,* but it is agitated by occasional *emotion,* and it undergoes a gradual tonic spasm or contraction from the constant influence and direct action of the *vis nervosa:* nothing can be more distinct than the separate operation of these three causes or principles of muscular action in this instance.

1258. Let us next consider what occurs in some affections of the true spinal marrow: in one patient a pen could be grasped and held in its proper position for a moment or two by a strong effort of volition; but this was speedily overcome by the more energetic influence of the *vis nervosa,* and the pen could be retained in its proper position no longer. See *Plate* VII, *fig.* 7, 8, 9. In another case, the hand and arm shook violently, but it could be restrained for a few minutes, and for a few minutes only, by an energetic act of volition.

1259. On the other hand, stammering, and chorea, and the paralysis agitans, and other cognate affections of the true spinal system, are vastly aggravated by emotion: they are, on the contrary, suspended during quiet and undisturbed sleep.

1260. This remark leads me to observe that as in quiet sleep we have the absence of volition and emotion, and of their effects, these all return during dreaming, and on awaking. The *first* sleep especially, and the *transition* from sleeping to waking, are circumstances peculiarly connected with certain diseases of the nervous system, however the fact may be explained: hence the singular frequency of the attacks of the croup-like convulsion in infants late in the evening, and of epilepsy in adults on awaking in the morning.

1261. Are these events connected with dreaming or emotion, or do they arise out of the impaired condition of the respiration to which I have already adverted? The singular occurrence of epilepsy from sleep disturbed by external circumstances would lead to the former opinion, whilst that of asthma about midnight would rather lead to the latter.

1262. In a case of spasmodic tic, the features are not much drawn if the patient be quiescent; but the attempt to close the eye by means of volition excites a spasmodic action

which draws the eye-lids awry; and the acts of mastication on the affected side induce spasmodic distortion of the features of the whole side of the face.

1263. In this case, the act of volition excites the abnormal spasmodic actions into effect.

1264. To trace these principles of action in their healthy and morbid relations, must be very important. But this task can only be accomplished by long-continued observation, and in some cases by numerical deduction.

1265. I now proceed to pass in review, a little more particularly, the various diseases of the nervous system which can illustrate the question before us.

I. *Of the Diseases of the Cerebral System.*

1266. I first revert to the subject of hemiplegia. Pure and uncomplicated hemiplegia dissects and severs, as it were, the cerebral from the true spinal system, volition from emotion and the *vis nervosa*. One side is affected, generally the side opposite to that in which the disease of the cerebrum exists, and the face, tongue, arms, and leg are variously paralysed to voluntary motion. But the true spinal system is unaffected; the effects of emotion, and of the action of the *vis nervosa*, deglutition and respiration, and the powers of the sphincters, remain unimpaired. There is paralysis, as in cases in which the cerebral system alone is affected, and there is none of the spasmodic affection seen in diseases of the true spinal marrow. The saliva sometimes runs over the lip, the articulation is imperfect, the food collects on one side of the mouth during mastication, the tongue is protruded *to* the paralytic side,—the consequences of paralysis from cerebral disease; but, as I have already stated, deglutition is unimpaired, because the spinal system, of which it is a function, is unaffected. The arm is usually more affected than the leg, because the upper extremity is more distinctly devoted to voluntary movements than the lower extremity, which is more an agent of progression, and more under the influence of the excito-motory power.

1267. It is true that, in the previous attack of apoplexy, the respiration is frequently stertorous, deglutition imperfect, and the power of the sphincters impaired. But these effects

are to be connected with the state of apoplexy, and are probably due to counter-pressure on the medulla oblongata; and the danger of the case is in proportion to their manifestation and obstinacy,—a most important general fact in the prognosis. They persist in fatal cases, but they gradually subside in the others, together with the state of apoplexy and of danger.

1268. A distinction of great importance has recently been strongly insisted upon by M. Leuret, in his valuable work, "Du Traitement Moral de la Folie," viz. between mania with and without paralysis. Mania without paralysis is, according to M. Leuret, unattended by morbid appearances, hitherto detectible; but the physical changes of structure, and the loss of muscular power, are associated together. Volition is, as in hemiplegia, more or less severed from the muscular system by the organic changes.

1269. It rarely happens that, in other diseases of the cerebrum than hemiplegia, the diseased structure and the symptoms are so distinctly confined to the cerebral system. In apoplexy, the pressure, or rather the counter-pressure, is extended, as I have stated, to the medulla oblongata. The same event is observed in a still more marked manner in ramollissement, as is manifest from the spasmodic action of the muscles; the same event, too, is observed in the progress of effusion into the ventricles, which may frequently be traced in the gradual annihilation of some of the true spinal acts, as those of the eye-lids, and the occurrence of spasmodic affections, affections which do not result from disease the effects of which are restricted to the cerebrum.

1270. But whilst the influence of the disease is limited to the cerebrum, its symptoms must be limited to morbid effects on the senses, the judgment, the volition,—in a word, to the cerebral functions. In uncomplicated hemiplegia, we have paralysis of voluntary motion: but the influence of emotion, and of the *vis nervosa*, is more obvious even than before. The opposite side of the body is paralysed to volition; frequently the patient is seen bearing his hand and arm in a sling like an inert weight; but let him be agitated, let him yawn or stretch, and the arm is frequently immediately moved with extraordinary energy; let us examine his hand, and we shall frequently find it drawn forcibly to the side, the fingers

being forcibly contracted into the palm, communicating, on our attempts to open them, the idea of a steel spring*.

1271. The effect of hemiplegia, as I have said, is to paralyse the power of volition on the opposite side of the body, whilst the influence of emotion on this side remains. The seat, the source of these, must therefore be different. Those of the former are higher in the cerebrum, those of the latter lower down,—below the disease, probably in the medulla oblongata. Volition acts along fibres which decussate and affects the opposite side of the frame; emotion, like inspiration, has probably its course along another set of fibres, which do *not* decussate.

1272. We may conclude, then, that hemiplegia severs the different motor powers from each other, and demonstrates their individual and separate existence: the influence of volition is cut off; that of emotion is occasionally, that of *vis nervosa* constantly, energetic. Paralysis in regard to volition; agitation on occasions of emotion; tonic contraction from the *vis nervosa*; such are the facts presented to our observation and consideration. The last of these is portrayed in *Plate* VII, *fig.* 5.

1273. For cases illustrative of these phenomena of hemiplegia, I may refer to my former Memoirs.

II. *Of the Diseases of the True Spinal System.*

1274. Tetanus may be taken as the purest example of disease of the true spinal system. Whilst it spares the cerebrum, and with it the intellectual functions, it affects all those organs and actions of ingestion and egestion, and, in a word, of the excito-motory system, which, as I have stated, are spared by hemiplegia. Deglutition, respiration, defæcation, are variously impeded.

1275. The intellect is serene. The excito-motory power

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* In such cases the muscular irritability is, as I have stated in my *first* Memoir, augmented. But in cases of *very* long duration, I have found that, on the supervention of great emaciation of the paralytic muscles, the augmented irritability of their fibre, with the effects of emotion, of sudden cold, &c. and of the *vis nervosa*, gradually disappears. See and compare Memoir I.

is, on the contrary, augmented; the excito-motory actions morbidly violent. Every kind of emotion, every external stimulus, acts with tenfold violence.

1276. Any sudden or startling noise, as the cannon, the drum—any external impression, as a sudden jar, the contact of the cold air, &c.—are attended by the most painful and agonizing exasperation of the symptoms. Such, indeed, is the baneful influence of these various excitements, that I am persuaded that the very same treatment of tetanus may be successful or unsuccessful, according as we carefully avoid, or admit, the influence of emotion and external stimuli. Bearing this fact in our mind, the patient should be kept as free as possible from the intrusion of visitors, and should be carefully surrounded by an atmosphere of uniformly elevated temperature charged with moisture, every draught of wind and all exposure of the cutaneous surface being cautiously avoided. We all remember the case in which the sudden plunge into a cold bath proved fatal. Other but less severe agencies of the same kind may prove injurious, though in a less terrible degree. Stillness, and even darkness, are essential to the safety of the patient.

1277. I must once more advert to the influence of emotion in diseases of the nervous system. It is well known that the irregular movements in chorea and in incipient paralysis agitans subside during sleep. I was long perplexed to account for this fact. It was only by observing that these movements subside during *quiet* sleep only, and return during the agitation of dreaming, that I perceived that it is not sleep, but the absence of emotion, to which this effect is to be ascribed. Dreams during sleep have the same effect as emotion in our waking hours. In regard to stammering, I believe it would scarcely exist without emotion; it is certainly exasperated in a tenfold degree by every cause of emotion, and it is mitigated precisely in proportion to the mental quiet, composure, and self-possession of the patient,—facts which point to a principle of the utmost moment in the treatment of this disease. The true idea of stammering is, in fact, that of certain voluntary acts impeded and modified by emotion.

1278. But to return to the subject of tetanus. Traumatic

tetanus, being a series of morbid reflex actions, affords the type of affections of the system of incident and reflex nerves, and of their combiner, the true spinal marrow. The morbid influence is also retrograde as well as reflex. In disease originating in the spinal centre, the effect is usually less general, because less retrograde; but it is not less marked because more limited.

1279. Still more limited, in its effects, is disease seated in the reflex or muscular nerves. Such disease is seen in the cases of spasmodic tic and torticollis. Spasmodic tic frequently arises from the influence of exposure to cold: the first effect is generally paralysis; the second, tonic or clonic spasm,—a fact not hitherto observed, and owing, I suppose, to the particular conditions of the nervous texture, at the earlier and later periods of the disease. This particular subject I propose to discuss more at length at some future period.

1280. I will now close the subject of the sources of muscular action in diseases of the nervous system, by a few brief sketches, in which the different effects of volition and of the *vis nervosa* are distinctly seen.

1281. *Case* 1.—In a youth, aged about twenty, whom I visited after an attack, in which the speech became inarticulate, and the left arm affected with continual rapid spasmodic movements, the limb could be kept perfectly still for several minutes by a continual energetic act of volition.

1282. In this case, the influence of volition antagonized and controlled that of the *vis nervosa*. In the following case, this interference was, if possible, still more marked:

1283. *Case* 2.—This patient's case has been already noticed in this Memoir, § 1257. The patient can hold and retain his pen in a proper position as long as his attention is kept up to perform a constant and energetic act of volition; the moment the attention and the consequent act of volition are relaxed, the pen assumes the several positions beautifully portrayed in the sketches given *Plate* VII, *fig.* 7, 8, 9, in consequence of involuntary movements, the result of morbid acts of the *vis nervosa*.

1284. A similar effect from energetic voluntary effort is seen in chorea, and, as has been stated, in stammering. The patient can guide his hand and his leg, whilst volition is more

energetic than the *vis nervosa*. The disorderly movements from the morbid activity of the latter return when volition is less energetic. This fact may be illustrated by the following interesting extract from the elegant work of Heberden:—"Puero cuidam cum crura vehementer agitabantur, motus involuntarii superabant omnes movendi conatus leniores; membris autem fortius impulsis morbus superabatur: ergo currere potuit, qui non potuit ambulare*."

1285. *Case* 3.—The next case is one in which the third finger was rather rigidly and permanently contracted by the influence of the *vis nervosa*. It was very little under the control of volition. It is sketched in *Plate* VII, *fig.* 6. The patient recovered under the influence of issues and mercury.

1286. *Case* 4.—The following case I owe to the kindness of the late Mr. Brayne of Banbury:—

1287. "The patient, a brazier by trade, and about forty-five years of age, had spinal angular curvature, extending through several of the dorsal vertebræ. The peculiar feature of the irritation of the cord, in addition to the usual symptoms of more or less paralysis of the sentient nerves, was great and incessant spasms and contractions of the muscles; chiefly of the flexors of the lower extremities, and also of those contracting the passage of the alvine and urinary secretions. Sometimes the urine would be forcibly ejected, and at another time the introduction of the catheter was exceedingly difficult. The irritation of the motor tract was so severe in its effects on the muscles of the thighs, that the heels were pressed so strongly against the buttocks as, at one time, to create ulceration. After death, a *rough* nodule of bone, like an exostosis, was found to project from the body of one of the vertebræ, about the middle of the curvature, to the extent of half an inch into the canal of the spine, and, no doubt, was the cause of the severe marks of inflammation and disorganization which the cord and its coverings at that point presented, and occasioned the symptoms in question." See *Plate* VIII, *fig.* 8.

1288. *Case* 5.—I must next notice the case of an infant, some months old, in which the crowing inspiration distinctly

* Commentarii, &c. ed. 1807, cap. xx, p. 93.

occurred once or twice, with the spasmodic affection of the hand portrayed by *fig.* 10 and 11, *Plate* VII, and a state of opisthotonos; several times there was such impaired deglutition as to threaten suffocation, on merely giving a tea-spoonful of water. The following is an account of the post-mortem appearances: There was slight effusion into the ventricles, and more considerable effusion under the arachnoïd at the base of the brain; and the medulla oblongata was very, I think morbidly, consistent. Besides these, there were *no* morbid appearances—no granulations in the arachnoïd, no tubercles in the lungs, no disease of the mesenteric glands.

1289. A similar state of contraction of the hand, and of the toes, from teething, &c. is by no means unfrequent.

III. *Conclusion.*

1290. It may be inferred, I think, from the preceding cases and observations, compared with experiments*, and the recorded facts in regard to hemiplegia, that the seat of volition is the cerebrum, and that its action is along the fibres which *decussate* in the medulla oblongata; and that the seat of emotion is below that of volition, and that it acts along fibres which probably do *not* decussate. In these respects the effects of emotion resemble those of respiration, as seen in yawning. This function is known to act in a *direct* manner, from the medulla oblongata not decussating. The same remark, and for the same reasons, may be made in regard to the tonic action of the *vis nervosa.*

1291. Volition has an object, an aim. Emotion and the *vis nervosa,* however subdued to certain laws impressed by the Creator, and destined to special purposes, are aimless on the part of the individual, nay, frequently *opposed* to his volition, as in *Case* 2.

1292. According to the views of M. Flourens, and according to the emphatic expression of Professor Müller, volition acts upon the fibres of the medulla oblongata, as the finger upon the keys of a harpsichord. So do emotion and the *vis nervosa.* Where then is the difference of the effect produced? These agents act upon different instruments!—Volition

* Flourens, du Système Nerveux.

along the intra-vertebral *cord* of cerebral *nerves;* emotion, and the *vis nervosa,* upon the fibres of the *true* spinal *marrow.*

1293. In *Case* 2, the functions of the spinal marrow were disordered. No force of the finger can produce harmony from an instrument out of tune. If volition had acted through the deranged organ, the result would have been a disordered act, instead of the regular action observed. It was the *vis nervosa* which, acting upon the deranged organ, induced morbid actions. This fact, this case alone, appears to me sufficient to establish the distinction between the cord of cerebral nerves and the true spinal marrow.

1294. The same conclusions must be drawn from the facts observed in paralysis agitans, chorea, &c. Opposed to volition, augmented by emotion, the movements observed in these diseases depend upon the *vis nervosa,* the motor power of the true spinal marrow, directly, or according to a reflex operation, and augmented by emotion.

1295. I have thus treated of the different sources of muscular motion, volition, emotion, the direct and reflex influences of the *vis nervosa,* the irritability of the muscular fibre.

1296. Early in the next session, I propose to lay before the Society a Memoir, which I have been long preparing, "On the *Plan of Observation* of Diseases of the Nervous System." It will relate to the following topics:

1297. 1. The effects of *irritation* and of *counter-irritation,* of *pressure* and of *counter-pressure,* in diseases within the cranium or the spinal marrow: the discussion of this topic leads to—

1298. 2. The question—why, with *similar* symptoms, we have *dissimilar* morbid appearances within the cranium, and vice versâ?

1299. 3. What are the diseases of the nervous system in which we find, generally speaking, *no* morbid appearances on a post-mortem examination?

1300. 4. What are the distinct diseases of the cerebral, the true spinal, and the ganglionic systems?

1301. 5. What is the spinal anatomy of the *base* of the encephalon, and its relation to cerebral diseases ?

1302. 6. What is the influence of disease of one of these systems upon the other respectively ?

1303. 7. In what order do the affections of these systems succeed each other ?

1304. Of all the parts of the encephalon which require study in the investigation of cerebral diseases, the *base* is the most important. Its anatomy is so extremely complicated ; and it constitutes in so remarkable a manner the region where the cerebral and the true spinal, and, indeed, the ganglionic, systems exist together ; that it must be obvious to the anatomist and the physiologist that the pathology of this spot must be extremely complex and important.

1305. This pathology may be the result of disease situated immediately in this region, or of counter-irritation or counter-pressure in diseases seated more remotely.

1306. The state of the pupil, the occurrence of strabismus, of vomiting, of priapism, and of the rigidity and spasmodic and convulsive affections in general, are to be thus explained. The difference in the effects of rapid and of slow diseases,—tumors, effusion, &c.—the difference of symptoms in the same disease, and the similarity of the symptoms in different diseases,—are thus to be viewed. Nature's laws are constant. And it is only because we do not understand them, that certain cases appear to be anormal.

1307. I conclude these Memoirs by calling my readers' attention to *Plate* II, *fig.* 1. Whilst it represents the *Cerebral System,* as distinguished from the *True Spinal* and the *Ganglionic,* it presents us with an interesting *Table* of the different kinds of Paralysis, with their special effects :—

TABLE OR LINES OF CEREBRAL AND SPINAL PARALYSIS.

Compare with Plate II, *figure* 1.

I. *The Line* A B *denotes*
1. *Paralysis of the Cerebrum, excluding*
2. *Sensation and Voluntary Motion ; whilst*
3. *The Effects of Emotion,*
4. *The Direct and Reflex Actions of the Vis Nervosa, remain, with*
5. *Augmented Muscular Irritability.*

II. *The Line* C D *denotes*
1. *Paralysis of the Cerebrum and of the Medulla Oblongata, excluding*
2. *Sensation and Voluntary Motion, and*
3. *The Effects of Emotion ; whilst*
4. *The Direct and Reflex Actions, and*
5. *The Irritability of the Muscles, remain.*

III. *The Lines* G H, H I, *denote*
1. *Paralysis of the Cerebrum and of the whole Spinal Marrow, excluding*
2. *Sensation and Voluntary Motion,*
3. *The Effects of Emotion ; with*
4. *Its Direct and Reflex Actions ;*
5. *The Irritability of the Muscles being impaired or lost.*

CHAPTER VII.

DISEASES OF THE NERVOUS SYSTEM IN ADULT AGE.

1308. I NOW proceed to treat of the individual diseases of the nervous system in adult age.

SECTION I.—*Of the Diseases of the Cerebral System.*

I. *Of Encephalitis.*

1309. Encephalitis must be distinguished into—

1. *Inflammation of the Membranes,*
    1. *Of the summit;*
    2. *Of the ventricles;*
    3. *Of the base;* and
2. *Inflammation of the Substance,*
    1. *Of the principal divisions of the cerebrum.*
    2. *Of the cerebellum.*

1310. The former of these might be distinguished by the term *cerebral meningitis;* the latter by that of *cerebral myelitis.*

1311. The *causes* of encephalitis are mechanical injuries of the head itself,—blows, falls, contre-coups; excessive mental application, anxiety, &c.; the intemperate use of spirits; exposure to the sun-beams, &c. Frequently encephalitis forms a complication of other diseases of the system, or of distant organs, especially fevers, the exanthemata, and dropsies. It is also frequently the *effect* of other diseases of the encephalon itself; it is excited round the coagulum, or cyst, in cases of cerebral hæmorrhage, tumors, tubercles, &c. It is also sometimes excited by ossifications, or projecting spiculæ of tone. Meningitis and myelitis frequently excite each other. M. Lallemand details a case in which a ligature applied to a part of the *right* brachial plexus induced inflammation and suppuration of the *posterior* part of the *left* hemisphere of the brain.

1312. Encephalitis is said to have followed the suppression of the catamenia and other discharges. It is sometimes connected with rheumatism.

1313. The *symptoms* of this disease first manifested are affections of the *cerebral* functions; affections of the *true spinal*, and of the *ganglionic* functions, follow in their turn. These symptoms vary much in the *first* and in the *later* stages of encephalitis.

1314. The *very first* symptoms are affections of the sensibility: the earliest, the most important, sometimes the *only* symptom, is *pain*, or cephalalgia; this is variously situated, not always acute, but sometimes excruciating. In addition to pain, there is frequently intolerance of the eye to light, of the ear to sound, and occasionally of the skin to touch; to these are added the sense of flashes of light, or of sudden noises.

1315. The *next* symptoms are affections of the mental faculties, sleeplessness, or disturbed sleep, restlessness, delirium—sometimes violent,—moroseness, stupor, unwillingness to be disturbed.

1316. The *third* source of the symptoms is volition: there are various voluntary motions, denoting either pain or delirium.

1317. Besides these affections of the voluntary movements, there are, in meningitis, spasmodic movements; and in myelitis, spasmodic, alternating with, or followed by, paralytic affections, which strongly characterise these different forms of encephalitis.

1318. The symptoms which belong to the *true spinal* system are very peculiar: the *first* of these is *vomiting;* this symptom should therefore never be neglected; the *second* is *strabismus;* the *third* is some decided *spasmodic,* or even *epileptic,* attack.

1319. The symptoms which belong to the *ganglionic* system are more obscure: the pulse is frequent; the bowels are frequently constipated, but the secretions are, at the first, little affected.

1320. It will assist our memory, in reference to the symptoms of encephalitis, to bear in mind the arrangement of the cerebral and true spinal functions which I have already

given. We should *use* it, however, as Sydenham did his theories; that is, in such a manner that we can cast it from us, and give ourselves up to pure observation, when we get into actual practice. Diseases *will not* suit themselves to our plans. Encephalitis, for example, is sometimes marked almost solely by violent delirium, and is then the *phrenitis* of nosologists; sometimes an early, if not the first, symptom is convulsion; sometimes there is violent headach, as the chief symptom. In other cases, this disease is insidious in the highest degree; the patient seems *idle;* perhaps is suspected of *feigning;* he will not move or speak; and there may be *no* other marked symptom. We must beware of these things. We should cultivate an independent spirit of observation.

1321. There is no symptom perfectly diagnostic of meningitis and myelitis. The former is more marked by acute pain, delirium, and convulsions; the latter by muscular contractions, alternating with, or followed by, paralysis.

1322. The second stage of encephalitis is denoted by diminished sensibilities and mental faculties; the pain and delirium subside into insensibility, stupor, coma; the spasmodic into paralytic affections. There may be blindness, deafness; the pupils are generally sluggish or incontractile on exposure to light.

1323. Eventually the true spinal functions suffer; there are permanent strabismus, difficulty in deglutition, stertor, and other affections of the respiration; relaxation of the sphincters, &c.; the pulse varies much in frequency; the bowels are apt to be constipated; the urine is often scanty.

1324. The insensibility of the patient frequently leads to a particular event; he is unconscious of the existence of a disease, which, under other circumstances, would induce great pain. Complications with encephalitis are, therefore, apt to be overlooked. One event I must point out in an especial manner: from insensibility, the patient does not void the bladder; this viscus becomes excessively distended, and there may be a stillicidium urinæ. In *every* case of insensibility, in *every* case of involuntary discharges of urine, we must examine the hypogastric region.

1325. There is another *practical* fact of much importance, to which I must draw attention: not only the dawn and the

course of encephalitis are insidious, but its termination is particularly so. In some cases, an unexpected state of *sinking* takes place, in which the symptoms, whether pain or delirium, &c. subside, and the patient is thought to be convalescent. The same event occurs in some other diseases, especially enteritis. We must beware of this fact, too, and suspect some such insidious change, unless *all* the symptoms concur to denote returning health.

1326. The principal morbid appearances left by encephalitis are—

In Meningitis.	*In Myelitis.*
1. *Injection.*	1. *Injection; tumefaction.*
2. *Effusion of serum.*	2. *Softening.*
3. *Effusion of lymph.*	3. *Purulent infiltration.*
4. *Effusion of pus.*	4. *Abscess, encysted, unencysted.*
5. *Ulceration.*	5. *Induration.*

1327. These morbid appearances may take place in various parts of the encephalon; those left by meningitis occupy the summit and the base of the brain and the ventricles; those induced by myelitis occupy the surface and the central parts, and any individual portion or portions of the substance of the brain.

1328. For further information upon these important points, I refer my readers, with great satisfaction, to the works of M. Andral and Dr. Abercrombie. The only point to which I would draw their attention particularly, is the fact that the inflamed brain is *tumefied*. This fact explains the occurrence of pressure, and its varied effects on different parts of the encephalon, frequently situated remotely from the part affected with inflammation, softening, &c. It is on this principle that we explain the occurrence of various affections of the true spinal system in inflammation of different parts of the cerebral system,—the strabismus, the vomiting, the various convulsions which occur in the early stage; and the stertor, the relaxed sphincters, &c. which occur in the later stages of encephalitis.

1329. The *treatment* of encephalitis embraces bloodletting, general and local, purgatives, antimonials, mercurials, cold lotions applied to the head, counter-irritation, &c.

1330. The efficacy and safety of *bloodletting* depend upon its prompt and effectual administration. I believe the *only* satisfactory mode of the institution of this important remedy is that which I have pointed out in my work on bloodletting. The patient is to be placed perfectly upright, looking upwards, and bled, from a good orifice, to *incipient syncope*. In this manner alone can we adapt the remedy to the nature and violence of the disease, and the strength of the patient. To *prescribe* a certain quantity of blood to be taken, is a dangerous, indolent, and unjustifiable proceeding; for it is impossible to know *a priori* what that quantity should be.

1331. This mode of instituting bloodletting also guards against some terrible mistakes, and yields an important diagnosis. There are *some* diseases *so similar* to encephalitis, that the most experienced physicians cannot be absolutely certain what a given case may be. These cases would be brought to a fatal issue, if the same quantity of blood were withdrawn in them as is both proper and necessary in encephalitis. If we adopt the rule for bloodletting which I have proposed, we shall be saved from the danger of inefficient bloodletting in the case of inflammation, and of undue bloodletting in these other cases, so similar to it in appearance, yet so different in reality; we shall also possess an accurate and important source of diagnosis. If it be inflammation, much blood will flow before the lip becomes pale; if it be of the other kind of disease to which I have alluded,—such, for example, as delirium tremens, and certain congeneric affections,—comparatively little blood will flow before that event occurs.

1332. Topical bloodletting is appropriate in cases in which some symptom or symptoms remain and we dare not deplete the *system* further.

1333. Purgative medicines, especially the active purgatives, as the oleum croti tiglii, and nauseating doses of antimonials, are powerful auxiliaries to the other remedies.

1334. The free exhibition of mercury, so as to affect the system, is distinctly useful in continued inflammatory affections of some serous and mucous membranes, as pleuritis, peritonitis, croup; and they have been strongly recommended in encephalitis. I had recently a very interesting case, in

which a state approaching to dementia, from meningitis, was cured by a long-continued mercurial course.

1335. Ice, an alcoholic lotion applied to the head, the cold-water douche, &c. are other powerful auxiliary remedies. The same remark may be applied to blisters, issues, or setons, applied on some convenient part of the head, or in the neck.

1336. It is important that the head should be raised, that the feet should be fomented and kept warm. It is important to prevent the patient's mind from being disturbed, or tried in any way; to keep the eye from the light, the ear from noises, &c.

1337. I must, in this place, recall to my readers' recollection the important remark made, § 725—. The sudden attack of encephalitis, or it may be pleuritis or peritonitis, after scarlatina or rubeola, is fatal, unless it be promptly met by bloodletting in the erect position, to incipient syncope; in effecting which, an extraordinary quantity of blood is withdrawn.

1338. I have detailed a most interesting case which occurred at Highgate: a boy, aged twelve, had had scarlatina in its slightest form sixteen days before; suddenly his face was *seen* to swell. He shortly became affected with appearances of *sinking*, and then with violent and almost continued *convulsions*, with coma, and dilated and incontractile pupils.

1339. What was to be done? Confiding in the protecting power of scarlatinous dropsy and of convulsion, I had him *bled* to ʒxxvii, from the jugular vein and arm. During the flow of blood, the convulsions ceased, the pupils became contractile, and the little patient recognized his father.

1340. From this time, the internal remedies, leeches, aperients, &c. were all that were required.

Section II.—*On Congestion and Hæmorrhage.*

1341. I now proceed to bring before my readers two diseases of the encephalon, certainly not less important, not less frequent, than encephalitis. They are apoplexy and paralysis, or, more correctly,

1. *Congestion without rupture*, and
2. *Hæmorrhage, or rupture.*

These affections, like encephalitis, may occur in—

1. *The membranes;*
2. *The substance of the brain.*

1342. The causes of the attack of congestion, or hæmorrhage within the head, are predisposing and exciting; the former are plethora, repletion; or, on the contrary, exhaustion, inanition, or debility; disease of the heart; indigestible substances in the stomach; some forms of acute anasarca; a constipated or other morbid condition of the bowels; deranged or suppressed function of the kidneys; disease of the arteries, or veins, or other tissues within the cranium, &c. The exciting causes are excess in eating, muscular efforts, especially straining, vomiting, sneezing, the recumbent posture, &c.

1343. As inflammation usually assumes an *acute* character, congestion and hæmorrhage are as generally *sudden* in their attack. There are frequently, however, certain *antecedent* symptoms, which denote the *threatening* of this attack, and which I shall take great pains to point out.

1344. I would remark, too, that these antecedent symptoms can only be observed and learnt, like those of many other diseases, in *private* practice,—I had almost said in the cases of the rich and affluent,—by which I mean that it is in such cases that we are compelled, by our very office, to remain by the patient, watching, anxiously watching every shade of change.

1345. These antecedent symptoms consist of headach, vertigo; a sense of pressure, a sense of confusion; incoherence, delirium; loss of consciousness, of memory; drowsiness; numbness, paralysis, spasm; giddiness, flashes of light, visual spectra, noises; pallor, sickness, vomiting; faintishness, &c.

1346. These symptoms are all *cerebral*, with the exception of the vomiting and of the spasm; the relation of the former of these to affections of the head has been already pointed out, but it cannot be insisted on too much. A fall on the head, inflammation, and other diseases of the encephalon, so frequently induce vomiting, as to make this a most valuable premonitory symptom in these cases.

1347. The *attack* of congestion, or of hæmorrhage itself, is frequently of the most sudden kind. There is total loss of sense and motion; the patient is flushed, comatose, breathes

with stertor, and the pulse is strong and full. This is probably the case of congestion. In the attack of considerable hæmorrage, there are the symptoms of *shock* inflicted upon the nervous system; pain of the head is followed by paleness, sickness, and vomiting, and fainting; coma, or paralysis, loss of speech, or of the power of swallowing, succeed immediately, or more slowly, probably according to the promptitude or the extent of the hæmorrhage. In the attack of partial hæmorrhage, these symptoms are observed in a slighter form; and it is some paralysis, hemiplegia, partial loss of speech, &c. which ensues. In one interesting case, such an attack as I have last described was followed in a few months by one of severer form, and the patient survived but a few days.

1348. It will be perceived that in these cases the true spinal system is affected in proportion to their gravity; to the loss of sense and voluntary motion are now added dysphagia, stertor, and relaxed sphincters; sometimes there are convulsions, sometimes contraction of the limbs; in other cases, as I have stated, sickness and vomiting. The important questions are indeed—1. Are the spinal functions implicated as well as the cerebral? and 2. Is this affection of the spinal functions persistent? The *danger* is precisely proportionate to the *degree* and the *duration* of these latter symptoms. If the stertor, the dysphagia, and the other spinal symptoms continue, in spite of early and efficient blood-letting, the case generally proceeds to a fatal termination.

1349. The ganglionic system suffers in its turn; the bronchia and trachea become clogged with mucus.

1350. The injection of inflammation is probably seated in the minute arteries and the capillaries, whilst the morbid anatomy, in these cases, consists in congestion or rupture of the minute veins and capillaries of the medullary substance of the brain. M. Serres treats of a meningeal apoplexy; M. Cruveilhier depicts an "apoplexie capillaire" of the substance of the brain.

1351. The meningeal rupture is both described and depicted by the late Dr. Cheyne, in his work on Apoplexy; by M. Serres, in the Annuaire des Hopitaux, tom. i, p. 246; and by Dr. Bright, in his Reports, vol. ii, pl. 5 and 15.

1352. The congestion of the substance of the brain is

readily understood; it is not always obvious on post-mortem examination.

1353. Rupture may occur in any part, and even in different parts of the brain, at once, or consecutively, and to any extent; it produces corresponding and proportionate effects: shock; paralysis, partial or general, and coma, in their various forms and degrees.

1354. Diffused meningeal apoplexy, extreme hæmorrhage, effusion into the substance or into the ventricles of the brain, induce general paralysis, or coma; partial hæmorrhage of a hemisphere, paralysis of the opposite side of the body; still more partial and circumscribed hæmorrhage, may affect the arm, or the leg only, or the speech. (See particularly § 154.)

1355. The appearances in cerebral hæmorrhage are very different at different periods after its occurrence: at first there is a mere coagulum of blood of various dimensions and form; afterwards, the colouring matter disappears, and fibrine, or serum, remains, enclosed in a cyst lined with a fine membrane, like the serous membranes; in some cases the sides of this cyst gradually approach each other, and remain in simple contact, or unite. The contents of the cyst sometimes become organised. The parts of the brain surrounding the hæmorrhage are frequently softened, sometimes as the *cause*, sometimes as the *effect* of the hæmorrhage; in old cases they are much indurated. The adjacent arteries are frequently diseased, beset with calculous or osseous matter, or affected with aneurysm.

1356. The treatment of congestion and hæmorrhage of the encephalon embraces the use of blood-letting, general and local, purgative medicines, the most rigid abstinence, &c. &c.

1357. The principal point which I wish to press upon my reader, in reference to blood-letting, is its different measure proper in mere congestion and actual rupture. In the former there is extreme tolerance of loss of blood; in the latter, the system is extremely, and even dangerously, susceptible of this loss. The diagnosis is frequently difficult. I have pointed out the most distinctive symptoms. In addition to an attention to these, I must repeat the important injunctions—to place *the patient* in the perfectly upright posture before the blood is allowed to flow; to watch his countenance, his breathing;

to keep *the finger* on his pulse; and, the moment the slightest indication of approaching syncope takes place, to arrest the flow of blood and place the patient recumbent.

1358. If early syncope occur, we must trust the future to local depletion by means of cupping to the occiput and the neck. If the patient lose a large quantity of blood without change, pursue and repeat the remedy boldly; his life depends upon ample depletion of the sanguiferous system: we must add to the energetic use of the lancet, that of the cupping instrument.

1359. The head should be covered with a spirit lotion; the feet should be fomented, involved in ample bran poultices, and sinapisms alternately.

1360. The bowels must be purged freely daily.

1361. The diet must be mere barley-water, rice, &c.

1362. The countenance, the respiration, the pulse, must, however, be watched, and the least disposition to debility cautiously noticed and remedied, even by stimulants, and especially by the carbonas ammoniæ.

1363. The next questions relate to the treatment of the paralysis, should the patient survive, or escape, the attack of apoplexy. I must suppose all inflammatory action dissipated. In this case, liniments and electricity may be tried, but especially voluntary movements of the limb. Is strychnine, is electricity, ever of advantage?

1364. Should not we rather be still contemplating the condition of the brain, and using the remedies proper for this cerebral disease, the source of the paralysis? Cupping, so as to induce irritation rather than withdraw blood, setons, issues near the part affected, that is, upon the hemisphere opposite to the paralysed side, are our principal remedies, but especially the first of these.

1365. In connection with cerebral *congestion*, I must revert to the subject of a remedy already noticed, § 909, 1178, but hitherto unemployed in these cases; viz. *tracheotomy*.

On the Use of Tracheotomy.

1366. There are many cases in which tracheotomy may be employed so as to afford *time* for remedies to act, without which the event must or may be fatal.

1367. This remedy has been suggested as applicable to hydrophobia. I formerly thought that this ingenious proposition had first been made by Mr. Mayo. I find it is really due to the late Dr. Physick, of Philadelphia. Dr. Randolph observes, in his Memoir of this eminent physician:—

1368. " In 1802, he published a paper in the New York Medical Repository, in which he communicates the particulars of a case of hydrophobia. In this communication he gives a circumstantial account of the appearances which were observed upon dissection; and as a means of affording relief in similar cases, he suggests, in conjunction with other remedies, the propriety of performing the operation of tracheotomy. The following quotation is sufficiently explanatory of the views which he entertained.

1369. " ' Reflecting on the symptoms which took place in the case above related, it appeared to me, that the dread of water arose chiefly from the convulsive or spasmodic contraction of the muscles of the glottis, which rendered the patient unable to breathe, and involved him in all the horrors of impending suffocation. When asked why he could not drink, he answered, that whenever he attempted to swallow any thing it took his breath away.

1370." ' Under the influence of these opinions I am disposed to believe, that tracheotomy would have saved my patient, at least for a time, if it had not altogether prevented the fatal termination of the disease. I cannot suppose that the spasms of the muscles in hydrophobia would be attended with much danger to life, were it not for their influence in suspending respiration.' * * * *

1371. " I am not informed that he ever had an opportunity of testing practically the value of the foregoing suggestion, by the performance of the operation."

1372. It is difficult to say what might be the benefit accruing from *tracheotomy* in hydrophobia. But the proposition would appear to be more fraught with hope in that form of *tetanus* in which the patient dies of asphyxia.

1373. But there are other cases in which tracheotomy promises to be most important. In *apoplexy from congestion*, in the *coma after epilepsy*, *in puerperal convulsion*, I am persuaded that the fatal event might be averted by the timely adop-

tion of this measure. The patient dies of asphyxia, and of an asphyxia which tracheotomy would, I believe, prevent; or of coma, which blood-letting would cure! I need not say more. I wish to make my young reader *think*, and I have stated enough for *this* purpose.

1374. But I must call the attention of the profession to another interesting case:

1375. There *is* such a case as paralysis of the pneumogastric nerve, and of the dilator muscles of the larynx; it occurs in deep intoxication, and probably in other cases of coma, as in that of apoplexy, of epilepsy, from opium, &c.

1376. A patient affected with such paralysis from deep intoxication was rescued from impending death by tracheotomy, at the suggestion of Mr. Sampson of Salisbury. The case is published in the Medico-Chirurgical Transactions, vol. xx, p. 45, and forms one of the *most splendid achievements of modern surgery.*

1377. This important case I give entire, for it does not appear to admit of abridgment:

1378. "Abraham Harris, aged 31, was brought to my house on the 31st of March last, in a state of complete insensibility from intoxication, the pupils being largely dilated, the breathing stertorous, and all voluntary motion having been lost for at least four hours before I saw him. The account given by those who came with him was, that he had attended a convivial meeting in the course of the day, at which he had drunk freely both of beer and brandy; his companions admitted that he had taken more than a pint of the latter; but it has since been ascertained that his glass was repeatedly filled up, without his knowledge, with white brandy instead of water, so that it is impossible to calculate what quantity of spirit he had actually taken.

1379. "I immediately used the stomach-pump, and drew off between three and four pints of fluid, a great part of which appeared to consist of brandy; after which, tepid water with ipecacuanha diffused in it was several times injected into the stomach, and after a while withdrawn again, with a view to excite vomiting, and thus rouse the energies of the brain. Finding, however, that these means failed, a strong solution of salt in water, and afterwards the sulphate

of zinc, were repeatedly tried, without any better result; but he became, if possible, more comatose, the countenance turgid, breathing more and more difficult; the pulse grew fainter, and was at last scarcely perceptible; at the same time, the whole surface of the body was cold and clammy, and he was insensible to every kind of stimulus. As he was some miles from his home, I had him removed to the Infirmary, and called a consultation of the other medical attendants, who arrived in the course of half an hour; but as, in addition to the above symptoms, he had lost the power of swallowing, and every appearance indicated the rapid approach of death, nothing was ordered for him but a turpentine injection, there being no ground to justify a reasonable hope of recovery.

1380. "At this period, it occurred to me, whilst standing by his bedside, that the comatose state in which he lay might not arise from apoplexy, but from torpor of the brain, in consequence of that organ being supplied with blood not duly oxygenated; for the shrill tone and extreme difficulty of respiration shewed the existence of collapse of the glottis, and imperfect transmission of air into the lungs, which might be accounted for by a paralysed state of the eighth pair of nerves and recurrent branches. With this view of the case I again appealed to my colleagues, and strongly urged that a trial should be given to the operation of tracheotomy; for I could not but hope, that, if mechanical respiration were carried on for a time, the blood might regain its proper stimulant properties, and restore the energies of the brain and nervous system. Upon their consenting to give him this chance, the operation was performed, without loss of time, by Mr. Andrews, under whose care, as surgeon for the week, the patient was now placed.

1381. "The trachea was no sooner opened than the distension of the veins about the head and neck subsided, the violent efforts of the extra-respiratory muscles ceased, and in about half an hour regular and easy respiration through the wound was completely established; at the same time, the pupils became slightly sensible to the stimulus of light, and the pulse returned to the wrist. The immediate result of the operation being thus far satisfactory, nothing remained to be

done but to give directions for the frequent removal of the mucus, which appeared at the wound, and to keep the surfaces of the incision asunder until the integuments and muscular layers had become agglutinated to each other: this latter object was effected by means of a piece of strong spring-wire, with a bow at each end of it, which, being introduced in a bent state, was allowed to expand, and the opening in the trachea was thus prevented from being covered by the muscles, even during the efforts of deglutition.

1382. "He continued perfectly quiet during the night, but had no return of consciousness until the following morning, when he gave us to understand, by signs, that he suffered from headache and soreness at the pit of the stomach; there was a tendency to sickness, and the tongue was coated with a peculiar whiteness, as if rubbed over with chalk. Moderate purgatives, followed by mild alkaline medicines, soon removed these symptoms, and a few leeches were applied to the throat, for the purpose of checking too high a degree of inflammation; after which, no further treatment was required; but the wound being healed in about three weeks, he was discharged cured, and has continued up to this time in the enjoyment of perfect health."

1383. Sufficient has been said to demonstrate the *practical* importance of this question.

1384. It must be remembered—1. that dashing cold water on the face opens the larynx, and induces inspiration; 2. that there is one other measure to which recourse should be had more frequently: it is the induction of vomiting by irritating its excitors in the fauces; 3. that these and other measures must of course be fully tried before we proceed to the more formidable remedy of tracheotomy; 4. but that tracheotomy is a most important resource, and to be instituted when —*the others fail*, and *before it is too late.*

Mode of Action of the Causes affecting the Nervous System.

1385. It may be stated, as a general principle, that the *first* effect of injury done to the nervous system, is a diminution of its functions; whilst the second or ulterior effect is the augmentation of those functions.

1386. If we divide the spinal marrow in the frog, there is at the first a cessation of the reflex actions with that of the circulation; by and by, these return; after a time, their force is morbidly augmented.

1387. In injuries of the brain and of the spinal marrow, in man, the same series of phenomena is observed.

1388. When the trifacial nerve is injured by exposure to cold, there is at first numbness; afterwards, perhaps, painful tic.

1389. When the facial nerve is affected by severe cold, there is, at first, *paralysis*, and the face is drawn to the opposite side; afterwards there is *spasm*, and the face is drawn to the side affected.

1390. In other instances, the first effect of the disease or injury subsides, without any subsequent augmentation of function. In hemiplegia, the paralysis of the face, the lips, the tongue, the leg, the arm, generally becomes mitigated, in the order in which I have enumerated these parts, as the disease subsides, or is mitigated by our remedies.

1391. In like manner, the other diseases which I have enumerated may pass from the first stage into a state of mitigation or recovery, without passing into the second stage.

1392. On the other hand, the symptoms of the first stage may go on augmenting until death ensue, or the loss of the use of the limb or part affected be complete.

Localization of Diseases of the Cerebral System.

1393. I have already discussed this subject, from § 120 to § 162. I resume the subject only to make a few observations on the

Effects of Disease of the Cerebellum.

1394. Many considerations induce me to think that disease of the cerebellum induces its peculiar effects on the genitive organs, by irritating the medulla oblongata.

1395. The experiments of M. Flourens*, the experiments and clinical observations of M. Serres†, and similar observations of M. Andral‡, are the principal sources of our knowledge of this subject.

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* Recherches, &c. p. 36.

† Anatomie du Cerveau, t. ii, p. 601; Journal de Physiologie, t. ii, pp. 172, 249.

‡ Clinique Médicale, t. v. p. 658.

1396. M. Flourens considers the cerebellum to be the organ of equilibrium in the movements of the animal frame, judging from experiments of the most interesting character.

1397. M. Serres' opinion is that of Dr. Gall, founded upon new experiments and cases,—that the cerebellum, and especially its median lobe, is the excitor of the genital organs. I think neither these experiments nor cases sufficiently isolate the functions of the cerebellum and of the upper part of the spinal marrow. The median lobe of the cerebellum can scarcely de diseased without affecting the medulla oblongata. And the experiments seem also to have involved an injury of that part of the nervous system, as we may judge from the following extract:

1398. " Sur des bœufs abattus en portant des coups de marteau sur la partie postérieure de l'occipital, j'ai rencontré le cervelet déchiré dans sa partie supérieure, chez ceux chez lesquels la verge avait offert pendant l'expérience un mouvement d'oscillation très-prononcé.

1399. " Sur un cheval entier dont la jambe avait été écrasée par une voiture, un couteau à amputation plongé sur le lobe médian du cervelet, d'avant en arriere, *jusqu'au haut de la moëlle épinière*, détermina une érection très-prononcée.

1400. " Mais ce résultat a surtout été constaté depuis la publication de ces faits, par un de nos habiles physiologistes, M. le Professeur Ségalas.

1401. " Si sur un cochon-d'inde mâle dont on a mis le cerveau à nu, dit ce physiologiste, on plonge un stylet dans le cervelet, *de manière à arriver à la partie supérieure de la moëlle de l'épine*, on produit l'*érection ;* si l'on pousse ensuite le stylet dans la colonne vertébrale jusques dans la région lombaire, l'*éjaculation* a lieu, tandis que la vessie, fût-elle pleine, n'en conserve pas moins son dépôt. Les mêmes phénomènes s'observent dans les cochons-d'Inde décapités, quand on agit de même avec un stylet de haut en bas sur la moëlle de l'épine.

1402. " Cette dernière expérience, que j'ai répétée et dont chacun peut s'assurer par soi-même, prouve deux choses: la première, que l'irritation du cervelet détermine l'érection ; la seconde, que la partie inférieur de la moëlle épinière pro-

duit l'éjaculation, et agit plus spécialement sur les appareils sécréteurs du sperme*."

1403. M. Andral observes†,—" Dans les trente-six cas que nous analysons, il n'est question que trois fois de l'appareil génital. Dans un de ces cas, on observa une érection permanente du pénis pendant tout le temps que la malade fut suivi. Il y avait dans un de ces cas une compression exercée à la fois par une masse tuberculeuse et sur le lobe droit du cervelet, et sur *le bulbe rachidien ;* (observation du docteur Sorlin, consignée dans la *Thèse* de M. Léveillé)."

1404. I beg my readers' particular attention to the words which I have marked by italics.

1405. Vomiting sometimes occurs as a prominent symptom, as in many other diseases of the encephalon. This, as well as the affections of the genital organs, is obviously a result of irritation of the medulla. M. Andral observes‡, with great justice,—" Dans le point où l'on découvre une lésion, ne réside pas toujours la cause directe des effets qu'elle produit, et, suivant qu'elle retentit sur tel ou tel autre point spécialement destiné à l'accomplissement d'un certain acte, c'est celui-ci qui se trouvera modifié."

1406. Convulsions are more frequent in diseases of the cerebellum than paralysis. They affect many parts, and resemble epilepsy; or only one part. There can be little doubt that it is the adjacent medulla oblongata which is really irritated so as to produce these phenomena.

1407. In some instances there has been a loss of balance, such as occurs in intoxication.

1408. Sometimes the sensibility has been affected,—exalted or impaired. In some cases there has been amaurosis.

1409. Diseases of the cerebellum, when they induce paralysis, usually affect the *opposite* side of the body, and the inferior more than the superior extremities.

1410. The subject of disease of the cerebellum is beautifully illustrated by the subjoined case, for which I am indebted to my friend Mr. Squibb:

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* Anatomie du Cerveaux, t. ii, p. 605, 609.

† Op. cit. t. v. p. 735.

‡ Op. cit. t. v. p. 734.

1411. "Mr. ——, butcher, aged fifty-eight, had been exposed to much fatigue and mental anxiety, when, about a twelvemonth ago, he was attacked with the influenza. This left him extremely languid; and, soon afterwards, he complained of a difficulty of breathing, and "odd feelings" about the heart. This continued for some months, varying at different times, but were subsequently relieved by a visit to Devonshire, from which he returned apparently much improved; but a renewal of his mental anxiety again produced lassitude and return of the dyspnœa. Within the last month, however, he considered himself better; and, the day previous to the attack for which I attended him, he remarked that he had not felt better for some time.

1412. "On the 17th of October, whilst attending in his shop, he complained of sickness, and called to Mrs. —— to support him, or he should fall. This was at three o'clock in the afternoon. He went to bed, and was seized with a most violent vomiting of *acrid* dark-coloured bile. This continuing, at seven o'clock I saw him. I found him much exhausted, with a cold skin, feeble pulse, constant *vomiting* and *grating of the teeth:* this was continual during the intervals of the sickness. He complained of no pain; was perfectly sensible, and begged that I could give him something to strengthen him. The bowels acted freely; he passed his urine, which was of a pale colour, freely. I prescribed for him the cordial rhubarb mixture with ammonia, and saw him again late that night. He was rather better, and I ordered him some pills with calomel and opium, to allay the vomiting.

1413. "He passed an extremely restless night; the sickness had continued, and he had vomited a hand-basinful of green and acrid bile; but at my visit at ten A. M. he was asleep. The skin was moist and warm; the breathing easy. Upon calling again in the middle of the day, he was easy; pulse quiet; skin moist; no sickness: he said that he was better; but there was an indistinctness of speech, which I had not perceived before. He was to go on as before. At seven P. M. upon entering his room, I found that they were about to send for me. He had become worse about six o'clock. He was restless, moving from side to side, and had called for ice to be applied to his head; he was then insen-

sible, and the vessels of the head were swollen, and the scalp hot. I immediately requested the assistance of Dr. Marshall Hall; and it was agreed that he should lose eight ounces of blood from the head, and have purgative medicines. Before he could be cupped, which was within an hour, stertorous breathing came on, and he died whilst being cupped: after losing ten ounces of blood, he was apparently relieved, when, in an instant, the pulse faltered, his countenance changed, and he died without a struggle.

1414. "*Post-mortem Examination.*—On opening the cranium, the cerebrum presented a healthy appearance, and the ventricles were found in a healthy state. On removing the brain for the purpose of further investigation, the weight of the cerebral lobes upon the cerebellum pressed out of its substance, on the right side and nearly continuous with the medulla oblongata, a clot of blood of about one ounce. On examining the cerebellum, which was softer than usual, the cyst which contained the blood was beautifully developed. The lungs presented a healthy appearance; but, upon a close examination, they were found gorged with a viscid, frothy, bloody fluid. The pericardium was healthy. The aorta presented no morbid appearance. The walls of the right ventricle were found thin and flabby; but the walls of the left ventricle were in a state of *concentric* hypertrophy, and the columnæ carneæ much thickened.

1415. "A curious fact relative to this case is, that for six months Mr. —— had lost all sexual desire, until the night previous to his attack (the 16th); eâ nocte cum uxore coivit."

1416. I have long been of opinion that disease of the cerebellum affects the sexual functions by irritating the medulla oblongata. My opinion is founded on the facts detailed, § 332, 1139, 1405—1452; and on the effects observed in strangulation, in some cases of epilepsy, &c.

1417. The case of disease of the *tuber annulare*, as depicted, *Plate* VIII, *fig.* 5, has been illustrated, § 152, 1160. Paralysis takes place on the opposite side of the body.

1418. The case portrayed, *Plate* VIII, *fig.* 6, of a clot of blood pressing on the medulla oblongata, was instantaneously fatal.

Section III.—*Other Diseases within the Encephalon.*

I. *Tubercles.*

1419. Besides the diseases which I have hitherto mentioned, there are others which may occur in the encephalon; these are tubercles, and various kinds of tumors.

1420. As inflammation, congestion, and rupture constitute acute and sudden affections of the brain, tubercles and tumors present us with slow and gradually progressive diseases of this organ. Not that this rule is without exception: for inflammation is sometimes slow and insidious in its accession; whilst tumors occasionally produce the sudden attack of an apoplexy.

1421. The difference between the same encroachment upon the cavity or contents of the cranium, formed promptly, or with extreme slowness, is enormous. Large tumors, slowly formed, may exist within the skull almost without a symptom; a clot of blood of the size of a pea, or certainly of a nut, in the substance of the brain, may produce hemiplegia!

1422. In speaking of tubercles of the brain, I must allude to the important law discovered by M. Louis, in regard to tubercles:—that, beyond the age of fifteen, tubercles are never found in *any organ* of the body without being present in the *lungs?* In a doubtful case, then, we examine the condition of the thorax: if there be tubercles there, it is a presumption that there may be tubercles in the encephalon; if there be no sign of pulmonary tubercle, it is a presumption that the affection of the brain is not tuberculous. But, as pulmonary tubercles are not always easily detectible, we endeavour to ascertain, in the absence of signs, whether there be other reasons for suspecting tuberculous formation,—such as an hereditary strumous or tuberculous disposition, the general or local signs of tuberculous affection in the system, or in any organ, &c.

1423. Otherwise the symptoms of tuberculous affection of the brain are not different from those of slow inflammation.

1424. Tubercles occur principally in the cortical and medullary substance of the upper part of the hemispheres; but

also in the cerebellum, tuber annulare, medulla oblongata, and spinalis; and in the peduncles, the corpora striata, and the thalami. They vary from the size of a millet seed to that of a pea or of an egg. They sometimes become encysted, especially as softening takes plate. They frequently excite increased and inflammatory action in the adjacent portions of the nervous mass, or induce pressure, whence the symptoms.

II. *Tumors of the Encephalon.*

1425. Tumors, and especially the scirrhous and encephaloid, may exist within the cranium. They have occasionally followed blows on the head; they frequently co-exist with other similar affections in other organs of the body.

1426. Developed slowly, they may exist with scarcely any symptom, or they may induce symptoms, on the principle, 1, of compression; 2, of irritation; and 3, of inflammatory action in the adjacent parts, of the brain, nerves, membranes, and the cranium itself. These symptoms are frequently induced gradually, sometimes suddenly; and are varied with the part principally affected. They consist of pain, followed perhaps by stupor; loss of smell, sight, touch, hearing, or taste; paralysis; or various convulsive affections, as strabismus, or even *epilepsy*.

III. *Hypertrophy of the Brain.*

1427. This disease has only been recently distinguished from other diseases of the encephalon. We owe our knowledge of it principally to MM. Bouillaud*, Dance†, Scoutetten‡, and Andral§. It has sometimes occurred in children; but most frequently between the ages of twenty and thirty.

1428. The brain is at once larger and paler than natural. In this latter particular it differs from inflammation or congestion, in which there is also a degree of tumefaction. On opening the cranium, the dura mater seems ready to burst; on removing this membrane, the convolutions of the brain

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* Traité de l'Encéphalite.

† Repertoire d'Anatomie Pathologique, 1828.

‡ Archives Générales de Médecine, t. i et t. ii

§ Clinique Médicale, t. iv, p. 595.

are so firmly pressed together, that the intervening triangular spaces have disappeared.

1429. The symptoms are those induced by compression: after long-continued pain, loss of intelligence and muscular power; convulsions; epilepsy.

1430. In one case only were these symptoms absent. It was the case of M. Scoutetten, which occurred in a little child aged five, in whom the cranium grew, pari passu, with the augmented size of the brain. This fact has been already noticed.

IV. *Atrophy of the Brain.*

1431. I have already alluded to the congenital atrophy of the brain, § 668. In this place I simply notice a fact which should not be unknown,—that the brain sometimes becomes atrophied in some part, especially of the convolutions, in the later, or latest, periods of life. Dementia and paralysis are the effects of this singular malady. Frequently the patient becomes utterly helpless, and passes into *second childhood*, as it is termed, the evacuations passing involuntarily.

1432. Sometimes the convolutions are simply reduced in volume; at other times they are puckered; in other cases there is induration.

1433. The patient lives a life of a mere excito-motory and nutritive kind. The cerebral functions are obliterated. The true spinal and ganglionic functions remain alone.

1434. There is much for the physiologist and pathologist to investigate in this singular *return* to a sort of infantile existence.

Section IV.—*On Mania, and Diseases resembling it.*

1435. It is impossible, in one short section, to discuss adequately this important and interesting subject.

1436. The most important consideration is, the *diagnosis*. Some cases of mere *nervousness* seem to border closely on mania. Some cases of *organic disease* of the encephalon seem to do so too. The diagnosis is essential to the proper treat-

ment of the patient, and the comfort of his connections and family.

1437. Treating first of mania, I may observe that

1438. The most important question in regard to the *causes* of mania, is, undoubtedly, hereditary predisposition.

1439. The most powerful of exciting causes is mental harass: the arduous duties of our prime ministers, the anxieties of the stock exchange, have frequently led to mania in its worst forms. Another set of causes of mania are the circumstances involved in the parturient and puerperal states, whether these be shock of the system, intestinal irritation, the loss of blood, the establishment of lactation, the condition of the uterine system, &c. I have had the most unequivocal evidence of the influence of loss of blood in inducing mania under other circumstances. Such a case is given § 1456—. Protracted lactation is also an undoubted cause of mania. A very morbid condition of the bowels also, indubitably leads to mental derangement: hence the term melancholia.

1440. But there is another cause of mania, in both sexes: "venus nimia, et præsertim solitaria." The latter is frequently the source of the inefficacy of all our plans of treatment, until it is detected and removed; and its removal is of extreme difficulty.

1441. Mania, when it does occur, assumes various forms: it is sometimes attended by an expression of the eye, and of the countenance, a manner, a demeanour, a loquacity, which denote the utmost excitement; in other cases it is moping melancholy, with a corresponding attitude and taciturnity; in a third instance there is a monomaniacal disposition to suicide or homicide; in a fourth patient we may have nymphomania; in a fifth, the patient refuses to take food; in a sixth, there is bulimia; in a seventh, coprismus; in an eighth, the cacoëthes to which I have just alluded, § 1440.

1442. The first symptom is frequently wakefulness. We must never neglect this symptom; it is so frequently the prelude to inflammatory or maniacal affections, that it should always be observed with extreme attention.

1443. Then some incoherent idea is expressed: love is changed into hatred; friends are viewed as enemies; pros-

perity as ruin; there are suspicions of a thousand kinds; despondency, or absolute despair; &c.

1444. Some word or expression will excite our attention to the impending evil, and then we must proceed to ascertain its particular cause or causes, its form, &c.

1445. The next important question is that which regards the morbid anatomy in mania. Is there any organic change? And if so, is it *cause* or *effect* of mania?

1446. M. Leuret has entered into a full discussion of the first of these questions, and has arrived at the following conclusion, which I give, as usual, in the words of its author:

1447. " S'il est vrai que la folie dépende d'une altération de l'encéphale, on ignore complètement en quoi consiste cette altération*."

1448. Admitting this question not to be absolutely determined, I may again ask—are the morbid appearances *cause* or *effect* of the mania? That they may be the effect, and that it has been too exclusively regarded as the cause, I can scarcely doubt. The appearances are usually deposits of serum and of lymph between the arachnoid and pia mater; sometimes effusion into the ventricles, sometimes injection of the cortical substance.

1449. If encephalitis is the frequent effect of mental harass and effort, why may not these appearances be the effect of the maniacal state?

1450. This question is an important one. If the view at which I venture to hint,—if mania be the *cause* of the morbid appearances,—our hopes are excited; if it be the *effect*, our fears are confirmed. Indeed, I have always observed that certain facts, such as the inveteracy of the case, a peculiar effect on the countenance, the manner, &c. lead to the formation of an unfavorable prognosis; and, I believe, because they denote the *supervention* of morbid changes in the encephalon.

1451. Why is the *moral* treatment so important? It is surely because it diminishes the violence of the maniacal condition, and so obviates its tendency to produce such morbid changes of structure, with its consequent hopelessness.

1452. Why is it so important to procure quiet, composed

* Du Traitement de la Folie, 1840, p. 7.

sleep? Obviously for the same reason. Sleeplessness, like mental effort, and the maniacal paroxysm, may induce morbid actions in the encephalon, and these may lead to morbid changes.

1453. The evidence from the morbid anatomy is quite deficient for practical purposes, unless we are enabled thus to distinguish cause and effect; and I fear this point has not been sufficiently considered by those who have addicted themselves to this department of medical science. It is sad to observe how a little effusion, a slight layer of lymph, is the *cause* of every thing, in the minds of some of these gentlemen of one idea.

1454. But there are other views of the subject. 1. May not the pathology of mania be entirely the result of *shock* to the nervous system, arising from *mental effort*, in one case, and *mental emotion* in the other? And, 2, may not that pathology be entirely *intra-vascular*, as in the case of *exhaustion* from loss of blood, undue lactation, &c.

1455. *Shock*, in regard to the nervous system, like *exhaustion* in reference to the vascular, is a subject of great novelty and importance, in its further reference to the practice of medicine, and one which I propose to myself for investigation. On the subject of exhaustion I have already published at some length. Referring to my other works*, I shall merely adduce, in this place, a case of temporary mania from bloodletting in a patient previously chlorotic; for the particulars of which I am indebted to the late Mr. Yates, who conducted the patient through her illness with the greatest attention and skill:

1456. "On the evening of the 22nd of January last, I was requested to visit L. A. aged twenty-six, who was represented to have been ill from cold several days. I found her suffering greatly, with impeded and painful respiration, flushed cheeks, accelerated pulse,—in fine, with all the symptoms of severe pneumonia. I bled her to fainting, whilst sitting upright in her chair: this took place after the loss of about twelve ounces of blood. Purgatives and sudorifics were prescribed for the night.

* See my treatises on Puerperal Diseases, and on Bloodletting.

1457. " I paid an early visit on the morning of the 23rd, and was informed that she had remained faint nearly an hour after the bleeding, and had breathed more freely and with less pain. The blood was cupped and buffed. Twelve leeches were directed to be applied to the chest. During the forenoon the symptoms resumed their formidable aspect; and, when I had the pleasure of meeting you in consultation, it was deemed proper to bleed her again, and that she should take a grain of the tartarized antimony every hour, until tolerance of the remedy should be induced. Venesection was performed in the erect position, and fainting again occurred when about fourteen ounces of blood had flowed. This, with the powerful effect of the antimony, gave relief during the remainder of the day: but when I saw her late in the evening, I felt called upon, by a renewal of symptoms, to have further recourse to the lancet; and again our patient fainted and was relieved.

1458. " The 24th was passed tolerably satisfactorily, without depletion. The bowels were relieved by appropriate medicines, and the effect of the antimony appeared sufficient for our purpose.

1459. " On the 25th, the pain and difficulty in breathing were more urgent; our patient was bled again to fainting. In the evening, the same remedy was required, and was followed by a similar effect. The tartarized antimony and aperient medicines were continued.

1460. " 26th.—The last basin of blood, containing about twelve ounces, was free from any of the inflammatory appearances so strongly characterized in all the former bleedings. Respiration free, with only a little pain in the left side, for which twelve leeches were applied: they bled copiously, and produced fainting. I prescribed the digitalis.

1461. " 27th.—Better in every respect; saline and aperient medicines were substituted for the digitalis.

1462. " From this time our patient became, progressively, apparently convalescent. She was soon able to sit up, though strictly enjoined to use no further exertion; her diet was rigidly prescribed, her appetite being exceedingly good; her bowels regularly influenced by medicine, and the secretions healthy. Indeed, the strictest attention was paid to every

thing connected with her restoration to health; and I observed nothing to call forth particular notice until the 17th and 18th of the following February, when she complained of great nervousness, being giddy, and occasionally forgetful of what she was saying or doing. I attributed this, at the time, to her weak state, and to a little alarm which had been excited by my having been called in during the night of the 15th, to attend the principal member of the family, who had become suddenly indisposed. I prescribed for her small but frequently repeated doses of ammonia, opium, and camphor, and a mild aperient, which had apparently the effect of quieting her.

1463. " On the forenoon of the 19th of February, I was requested to visit her immediately; but, having left home early, I did not receive the message till the afternoon, when I found her in a state of the greatest excitement, with flushed face, hurried respiration, rapid pulse, incoherence of conversation, and confusion of ideas, amounting to mania. I had some difficulty in pacifying her, to obtain from the alarmed attendants an account of the accession of these symptoms. It was represented that she had passed a restless night, and awoke in great agitation, and exclaimed she had seen a vision in her sleep, which impressed her with the idea of her having but six hours to live. Under such a delusion, she prevailed upon her attendants to send for a clergyman to administer to her the sacrament, who, seeing the state of her mind, very properly refused the rite. This was a new source of hallucination. She then could not die till I had seen her; and on my visit she hailed me as her deliverer from " the toils of earth and the wiles of Satan." I succeeded so far, by gentle persuasions, and unlimited promises to endless entreaties for relief, as to prevail on her to return to her bed. I prescribed sedatives, and enjoined quiet and restraint. In the evening of this day, you saw her, and will, I have no doubt, recall to your memory the religious madness you witnessed, which, although wild and fantastical in the extreme, still bore traces of a mind stored with something like sacred philosophy, as well as history, blending and confusing the real and the unreal with a skill which would bid defiance to the powers of a sane and superior order of intellect. A state of watchfulness,

with constant raving, supervened during the night, notwithstanding the administration of thirty minims of the tincture of opium, and fifteen minims given every two hours. The hair was cut off, and a spirituous lotion applied to the head.

1464. " 20th.—Symptoms little or not at all relieved. The opium was given in effervescing draughts, to allay the influence it had exercised on the stomach.

1465. " 21st.—Symptoms the same. Opium prescribed in substance. Cold applications to the head.

1466. " 22nd and 23rd.—State of the mind, if any change, rather more tranquil. Aperients required. Cold to the head. Opiates. Circulation more quiet, with more power.

1467. " For a few days the state of the patient was almost stationary, the treatment remaining the same. About the beginning of March, there was evident amendment in the bodily health, and the mind was susceptible of reasonable impressions, if made with calmness, perspicuity, and firmness; indeed, being given to understand that her health was now depending for restoration entirely upon the quiet of her mind, she exerted herself amazingly, and is now gradually recovering, being able to sit up for some hours during the day. Good appetite; quiet nights, with refreshing sleep; and muscular power daily improving."

1468. I must in this place briefly advert to certain cases of *perverseness of temper*, so *like* mania, that they require the same kind of treatment, only in a mitigated form. We want an *Asylum* appropriated to such distressing cases.

1469. From mania it is absolutely essential to separate

Diseases of the Encephalon, not Mania.

1470. In order to illustrate this subject, I may adduce the case of my own poor brother:

1471. He had a favorite horse. After an absence from home of several weeks, he visited his stable as usual. The

horse had, it is supposed, been teazed by the groom: however that might be, he seized my brother's coat and tore it from his back. From this moment he always suffered from headache, until some time afterwards, when he was seized with *hemiplegia* of the right side. He recovered greatly from this paralysis, but never perfectly. His speech especially remained less distinct than before. Gradually erroneous ideas took possession of his mind; he again became more and more paralytic, and his speech especially more and more inarticulate; whilst his mind lost its powers. It was but too obvious that *organic disease of the encephalon* was making gradual progress.

1472. At the time of his erroneous ideas, my brother was consigned to an asylum for the insane!

1473. When the brain was examined post mortem, the upper part of the *left* hemisphere displayed much alteration in structure, and the ventricles were distended with serum. No clot or cicatrix was discovered.

1474. This case admirably illustrates another want, which cannot but be much and keenly felt by the public. It is that of an asylum or *home* for those who, being paralytic and affected with erroneous ideas, require special care.

1475. The *treatment* of the insane is a subject of far too great importance and extent to admit of being discussed in this work. I can only afford space for an extract from a recent paper published in the Lancet by Philalethes, describing the benevolent and successful plans adopted at the Asylum of Moorcroft, by the late Mr. Stilwell. Philalethes observes—

1476. "Of all that has been done within the last quarter of a century, for the amelioration of the sad condition of the insane, by far the greatest part was accomplished, though within a narrow circle, by one now no more—one whose modesty kept him and his achievements hidden from the busy world, but to whose merits I have great pleasure in doing this act of justice. I speak of the late Mr. Stilwell, the proprietor of Moorcroft Asylum for the Insane, at Hillingdon, near Uxbridge.

1477. "Mr. Stilwell was a person of singular originality

of mind and benevolence of heart. No less qualities could have suggested the possibility of realising for the insane a peaceful English fireside, with all its associations, in exchange for the dungeon and the prison.

1478. "More than thirty years ago, when the low and and cruel despotism of the ignorant *keepers* of the insane was at its height, and when the clang of *chains* was loudest, this gentleman projected an asylum for the insane, which should be conducted *without keepers and without chains*, in which all possible liberty, compatible with the safety and good of the patients, should be permitted, and every comfort should exist which could make it worthy of the designation even of an Englishman's home.

1479. "Mr. Stilwell actually conducted this institution for the third part of a century, on this plan, without one single accident! And when I state that, during that period, the patients constituted, *bonâ fide*, one family, with himself, Mrs. Stilwell, and their five sons and one daughter, from their very infancy upwards—that they played together in the same garden, and took their meals together at the same table—I imagine every one will think with me, that the plan was one requiring no little courage, and its successful execution one requiring a watchful eye of no little steadiness. I confess, that to me its history at first presented the idea of a romance rather than of a reality; but its reality far exceeds any thing imagined or accomplished, even by Pinel or Esquirol.

1480. "Every thing which Mr. Stilwell did was judicious too: there was no rejection of important means of safety and benefit to the patient, though for eighteen months together the strait-waistcoat, for example, was never used; there was nothing pretended; all was real—all was English."

1481. It has recently been proposed to abandon *every kind* of restraint. But this is to reject necessary resources for the safety, and remedies for the malady, of the patient. What is required is, kind and judicious restraint, in the hands of kind and judicious guardians.

1482. But *the* all-important means of cure consists in *society* in which *decorum* and *gentleness* of conduct are *strictly enforced*. This *habit*, thus formed and long continued, allows the tone and health of the mind to be restored; and sixty per

cent. of patients so treated have returned to their own homes!

1483. Philalethes feelingly observes—"I would that our pauper lunatics, instead of being crowded in a gallery which presents a picture of misery, not to say of horror, were so placed, few in number, together, in what I will designate farm-house establishments."

Section V.—*On the Diseases of the Cerebral Nerves.*

1484. In treating of the diseases of the Cerebral Nerves, I must beg to refer my readers to the arrangement of these nerves formerly laid before them, and especially to remind them that they are divided into *sentient* and *voluntary:* see page 17.

I. *Of the Sentient Nerves.*

1. *Augmented Action.*

1485. Augmented action induces, in reference to the sentient nerves, various kinds of *pain*, the principal of which are those which occur in—

I. *Neuritis, or Inflammation, Ulceration, Tumors, &c. of the Nerves.*

II. *Neuralgia; Tic Douloureux; Hysteria.*

III. *Hemicrania Intermittens, Brow Ague, &c.*

1486. In reference to *inflamation of the nerves*, M. Descot observes,—"L'inflammation idiopathique aguë d'un nerf doit, je crois, se recontrer très-rarement.

1487. "Les nerfs sont quelquefois affectés d'une inflammation chronique, et on l'observe généralement à leur extrémité dans le moignon des membres amputés." "Lorsque les nerfs sont dans cet état, le moindre contact cause aux malades des douleurs assez fortes pour les obliger à se soumettre à une seconde amputation.

1488. "Dans beaucoup de cas de sciatique, je crois que le nerf sciatique est le siége de la maladie; la douleur suit, en général, si exactement le trajet du nerf, et les parties voisines sont tellement libres de toute apparence pathologique, que je crois que le nerf seul est le siége de la douleur; et

l'affection, ce me semble, doit naître d'une action inflammatoire dans le névrilème, laquelle se termine souvent par l'épanchement d'un fluide séreux." p. 195.

1489. The *subcutaneous tubercle* is attended with most acute pain, proceeding from one point, often extending along the course of the nerves, occurring in paroxysms, which take place spontaneously, or are occasioned by friction or other slight injury of the part, and which frequently disturb the night's repose. The case is distinguished by an examination of the part affected, when a small body, of the magnitude of about half a small pea, is felt under the integuments: this part is generally tender to the touch, especially during the paroxysm; and an acute pain is induced, and is extended along the nerves, by pressure.

1490. I published a case of this affection in the Edinburgh Med. and Surg. Journal, vol. xi, p. 466. It occurred in the thumb of a shoemaker, probably from the puncture of his awl. It was cured at once, after years of suffering, by excision. It is subjoined:

1491. In 1793, Mr. H. observed a slight bleeding from nearly the point of the fore finger of the left hand; and, being a shoemaker, he suspected that he might have punctured this part with the awl. Some time after this bleeding had ceased, an acute pain was experienced in the point of the finger, on putting the hand into the pocket, which contained some halfpence; and after this period the patient was always affected with very acute pain on touching any hard substance. Nothing was at that time observable on examination; at length, however, a small red speck was discovered within three lines of the point, and on the ulnar side of the finger. Soon afterwards, *paroxysms* of pain, unoccasioned by external injury, began to be experienced, during which, a little redness or tumor was observed in the part affected.

1492. About seven years after the commencement of this affection, the paroxysms of pain became more and more severe, and came on nearly regularly every fortnight, during the course of the *day*. At this period, an application of caustic was made with temporary relief. Some time afterwards, the patient resorted to the practice of paring away a small portion of the integuments over the spot, so deep as to

make the part bleed a little. This he did from time to time, and always with a certain degree of relief, probably by rendering the part less prominent, and consequently less exposed to external injury. From the period last mentioned, the paroxysms of pain became more severe and more frequent, until at length pain, in a more or less exasperated form, was nearly constant.

1493. About eight years ago, this pain began to be particularly urgent during the *night ;* and, during the last two years, a great part of each night's rest has been lost from it, an aggravation of the pain taking place about eleven, and continuing until three o'clock, in the course of each night. The part affected itself has suffered little change and little increase in size. It has been observed to be rather more tumid and red in the evening than in the morning, and during the paroxysms than during the absence or alleviation of the pain. In the paroxysms, the pain became more and more severe by degrees, and was accompanied by a painful sense of pulsation. This pulsation was irregular, and not experienced at each pulsation of the arteries. The pain extended to a considerable distance from the point affected, along both sides of the arm and along the middle finger; it was never felt in the thumb, nor in the other fingers; but sometimes the back of the hand and the root of the little finger on the outside were affected. In moments of acutest suffering, he experienced pain down the left thigh and leg to the toes. Occasionally, on touching any hard substance, the pain has been so excruciating as to induce fainting. The patient's suffering has always been particularly aggravated during any general indisposition, once during the continuance of a febrile affection from an accident, and at all times during the presence or aggravation of certain dyspeptic symptoms to which he has been subject. The pain was also aggravated during the prevalence of cold or wet weather. On washing the hand in cold water in the winter season, the pain was immediately induced, and the patient was obliged to expose the part immediately to the warmth of the fire for relief. Besides the application of caustic, and the removal of a small portion of the integuments already noticed, the patient has experienced temporary relief from the application of adhesive plaster, of

a blister, and of spirit of wine; and, during the paroxysms, by exposure to considerable warmth near the fire. On examination of the finger, a small, hard, red spot was observed about three lines from its point, on the ulnar side. The integuments were rather changed, and immoveable, over this hardness, probably from the different modes of treatment which had been employed. The spot was exquisitely sensible on rubbing or pressure; but the parts around possessed the ordinary degree of sensibility. The pain on pressure seemed to dart along the course of the nerve to the radial side of the middle finger, and upwards along the arm.

1494. The tubercle was extirpated by two free curvilinear incisions. The wound healed in a few days, the pain ceased, and the patient has experienced no subsequent uneasiness of any kind.

1495. Another form of neuritis is that which follows amputation. It is fearfully illustrated by the following detail, for which I am indebted to Mr. Bransby B. Cooper:

1496. "In June, 1834, a young married woman was admitted into Guy's Hospital with an "irritable stump," having submitted to three amputations under the following circumstances. In the first place, she fell across a fender, and produced such extensive injury to the wrist joint as to render it necessary to apply to a hospital for relief, and, I believe, was first admitted into the London Hospital, under the care of Mr. John Scott, who amputated the forearm above the wrist. Of this operation she recovered in the usual time, and was discharged as cured. In a few weeks, however, the stump became very irritable, and she suffered from neuralgic pains, which became so intolerable that she applied to St. Thomas's Hospital, when she was admitted under the care of Mr. Tyrrell. (I am not sure whether she was at St. Thomas's or the London Hospital first.) A second amputation was then performed,—still, I think, below the elbow,—when the same circumstances followed as after the former operation, perhaps with somewhat of an increase of neuralgic sufferings, when she fell under the care of Mr. Langstaff, who, after trying constitutional remedies, had recourse to a third amputation, above the elbow. In June, 1834, the stump of the upper arm giving the same suffering as she had before been sub-

jected to, she presented herself at Guy's Hospital, still willing to submit to any treatment which could offer any hope of permanent relief; and, after trying veratria, stramonium, belladonna both internally and externally, without affording any mitigation of her sufferings, she readily submitted to the only remaining means which afforded a prospect of success —amputation at the shoulder joint, which she bore with heroic fortitude, and described the suffering as being infinitely less than she had frequently experienced during the paroxysms of her complaint; nor, in the division of the trunks of the nerves, did there appear to be more pain inflicted than in amputations under ordinary circumstances. The wound readily healed, nor had she ever after any severe neuralgic symptoms, although for some time there seemed rather more irritability about the surface of the skin than usual. In about two months after the amputation, she left the Hospital, cured. I have several times seen this patient since; the last time about three years since, when she had had no return of her former distressing symptoms."

1497. The enlargements took place in the course of the nerves, *on* and *above* the divided portions. This fact may be compared with that quoted from M. Lallemand, § 1311.

1498. This and the former subject are most amply discussed by Mr. William Wood, in vol. iii, of the Transactions of the Medico-Chirurgical Society of Edinburgh, p. 317 and p. 367.

1499. Neuritis assumes the form of a *minute* tumor on the sub-cutaneous nerves, and of a larger one, designated *neuroma* by Mr. Wood, on the larger ones. In addition to Mr. Wood's paper, my readers may consult Swan, Descot, Abercrombie, Mayo, &c. All have written expressly on this subject. I hope also one day, instead of this brief account, to treat the diseases of the whole nervous system elaborately.

1500. The pain of *tic douloureux* occurs in paroxysms, which are sudden, irregular in their occurrence, frequently more or less transient or momentary, induced, when in the face, by the act of eating, or talking, or by the contact of external bodies with the acutely sensitive extremities of the nerves.

1501. This disease is distinguished by that which the term

tic means originally; viz. by a sudden contraction of several muscles, with distortion of the face. Its seat is various—in different parts of the face, of the limbs, and of other parts of the surface of the body.

1502. Many remedies have been proposed for this formidable malady, as division of the nerve, arsenic, carbonate of iron, &c. It frequently arises from derangement of the primæ viæ, which must be carefully corrected.

1503. *Hysteria*, assuming the form of nervous pain, is amply described by Sir B. Brodie.

1504. The *hemicrania intermittens*, or *brow ague*, is apt to recur in spring or autumn, from exposure to the north-east wind: it prevails in damp or marshy districts, and it is frequently observed to accompany the epidemic influenza. It frequently exists as a complication of intermittent.

1505. This ague pain occupies the brow, the temple, the forehead, the occupit, &c.: it occurs in paroxysms frequently of considerable regularity; it is often excruciating, occasionally inducing delirium, and, still more frequently, redness of the conjunctiva. It may recur, once, or twice, in the course of the day.

1506. This pain is almost certainly removed by the quinine or the arsenic.

1507. For a full account of these painful diseases, I may refer, with great satisfaction, to the works of Sig. Bellingeri and Sir Charles Bell; and to the still more recent works of Mr. Swan*, in this country, and of M. Descot†, in France.

1508. Sig. Bellingeri considers the *trifacial* to be a nerve of organic life, as well as of sensibility; M. Magendie speaks of it as influencing the nutrition and functions of the eye, &c.; M. Serres views it as the nerve of instinct; Sir Charles Bell, as a mere sensitive nerve. The view given of the subject in these notes is very different, and far more comprehensive. I consider this nerve, in addition to its office as a cerebral nerve, or nerve of sensation, and as forming a part of the excito-motory, and of the external ganglionic, *systems*.

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* A Treatise on Diseases and Injuries of the Nerves, new ed. 1834.

† Dissertation sur les Affections Locales des Nerfs; Paris, 1825.

1509. But, besides these views of the functions of the trifacial nerve, M. Magendie has discovered another. This nerve has a peculiar *influence* over the senses. M. Magendie observes, in his Précis de Physiologie, ed. 3, t. i, p. 100:—

1510. "J'ai coupé la cinquième paire sur un animal; aussitôt il a perdu la vue du même côté. Jai coupé celle du côté opposé, l'animal est devenu immédiatement aveugle. La lumière du jour, ni même une lumière artificielle très-forte, concentrée avec une loupe, ne donnent plus aucune indice d'impression." "Je coupai le nerf optique à son entrée dans l'œil; si le nerf de la cinquième paire ou tout autre pouvait sentir la lumière, la section que javais faite ne devait pas s'y opposer. Mais il en fut autrement; la vue fut complétement abolie, ainsi que toute sensibilité pour la lumière la plus forte, même celle du soleil, concentrée au moyen d'une loupe."

1511. The same observations are made in reference to the sense of smell and of hearing*.

1512. These experiments are not the only evidence we possess of the *influence* of the trifacial on *vision*. In the Archives Générales, t. xxiii, p. 260, there is a case of *amaurosis* of the left eye, arising apparently from caries and the presence of a portion of a tooth-pick of wood, in the first molar tooth of the left side, and ceasing nine days after its extraction.

1513. In an interesting case under my own care, a partial *amaurosis* of the right eye has arisen, apparently from caries of the upper canine tooth of the right side; it was augmented by unsuccessful attempts at extraction; it has not ceased, however, since the extraction was effected.

1514. These facts, with the similar results from wounds or tumors of the supra-orbitar branch of the trifacial, appear to me to confirm the extraordinary experiments of M. Magendie. This presents another subject demanding fresh investigation.

2. *Paralysis.*

1515. In an interesting case of a tumor, found at the anterior part of the base of the brain, the *olfactory* and *optic*

* See the Journal de Physiologie, t. iv, p. 169; 176; 302.

nerves were destroyed, and with them the sense of smell and of vision.

1516. The *optic* nerve may be subjected to compression or disease in any part of its course, from its origin to its termination in the retina itself. In one case, a partial loss of vision coincided with strabismus, the defective eye being drawn inwards. In another, there were, at the same time, defective vision and a spasmodic affection of the facial nerve of the same side.

1517. Amaurosis may occur in affections of the brain. It is frequent in hydrocephalus; rare in paralysis. It occurs from extreme loss of blood.

1518. I have already adverted to the difference between the case of paralysis of sensation of the face in hemiplegia, or from division of the *trifacial* in a part of its course *exterior* to the cranium, and that arising from the division or disorganization of this nerve *within* the cranium; § 148. In the first two cases the eye is unaffected; in the last, this organ gradually perishes,—as I imagine, from the destruction of its ganglionic or nutritive portion.

1519. This extraordinary fact was first ascertained by M. Magendie*, in experiments; it was then observed in the human subject by M. Serres†. It has since been witnessed by Dr. Alison‡, Mr. Stanley§, and other observers. See § 558, 565.

1520. In M. Serres' case, the right eye and the right nostril were insensbile; the left sensible; the gums scorbutic. On examination, the origin of the trifacial nerve, on the right side of the tuber annulare, was found diseased.

1521. Paralysis of the trifacial, in its exterior course, was first distinctly pointed out by Signor Bellingeri, in Italy, and afterwards by Sir Charles Bell in this country. The former of these writers has published a case, in his Dissertatio Inauguralis||, 1818, of paralysis, I think, of the trifacial and of the facial nerves. The precise nature of the case is not,

* Journal de Physiologie, t. iv, p. 176.

† Anatomie du Cerveau, t. ii, p. 67.

‡ Abercrombie on Diseases of the Brain, ed. 3, p. 424.

§ Ibid, p. 425.

|| See p. 125; and the Medico-Chirurgical Review for October 1834, p. 415.

however, certainly known, the patient having happily recovered.

1522. The most interesting case of this kind, which it has ever been my lot to witness, was that of Ruth Peters, aged sixty, who was repeatedly seen by my pupils during the session of 1836: this person was taken with pain of the right temple, deafness of the right ear, partial paralysis of motion and of sensation on the right side of the face—the right eye-lid being only slightly depressed on attempting to shut the eyes, and the mouth being drawn to the opposite side. These symptoms continued, and, in three months, precisely similar events occurred on the left side, in a severer form, the mouth being drawn to the right.

1523. These phenomena continued for a very considerable period. At length a small portion of bone fell upon the upper surface of the soft palate, and was eventually dislodged and rejected by the mouth. It proved to be a portion of the os sphenoides. The appearance of this bone affords an explanation of the interesting series of phenomena observed in this case. There was disease of the base of the brain, which interfered with the functions of the trifacial, the facial, and the auditory nerves*. (See p. 17, note.)

1524. I need scarcely observe that the eighth or auditory nerve is liable to pressure or disease within the cranium or within the ear, and that deafness is the consequence. Paralysis of the facial and of the auditory nerves not unfrequently exist together, as in the case which I have just related: this *coincidence* leads us to the conclusion that there is some *internal* disease.

1525. I must now draw my readers' attention to the *ninth*, or *glosso-pharyngeal* nerve. It has long been disputed whether the sense of taste be situated at the *tip* or at the *root* of the tongue. On this question another depends, viz. whether the nerve of taste be a branch of the *trifacial*,—long termed the gustatory, or of the glosso-pharyngeal, the former being distributed upon the tip, the latter upon the root, of that organ. The celebrated Scarpa, in his splendid work on the Nerves†, has detailed some novel and interesting experi-

* Compare Mayo's Anat. and Phys. Com. No. II, p. 12—15.

† Pages 16—17.

ments, from which he concludes that the sense of taste is situated at the tip of the tongue. He observes—

1526. "It is abundantly proved, not merely by anatomy, but by experiments lately made on the human subject by Alex. Volta, professor of Physics, that the sense of taste resides in the tip of the tongue, and in its margins, almost to the middle of its length; and that, beyond that part, as far as to the base of the tongue, there is either no sense of taste at all, or in a very feeble degree only. He applied a plate of zinc to the tip or margins of the tongue, and a silver spoon to the back of that organ beyond the middle part; the handle of the spoon was then brought into contact with the zinc, when an exceedingly acid taste was immediately perceived in the tip or margin of the tongue, which continued so long as the metals were in contact; but there was no sense of taste in the base of the tongue. It must not, however, be supposed that silver is incapable of communicating the electric impulse and stimulating the tongue; for, upon inverting the application of the metals, so that the silver is applied to the tip or margins of the tongue, and the zinc to its base beyond the middle part, when they are brought into contact, an acrid, burning, bitter, alkaline taste is perceived in the tip or margin, but none at all in the base, where the zinc is applied; hence it is evident that the principal and exquisite sense of taste is situated in the tip and anterior margins of the tongue, from its middle portion forwards, but that the rest of the base and the root possess merely the common sense of touch. By means of this very simple process any one can prove, by his own experience, that the acuteness of the sense of taste is proportionably diminished as the zinc or silver is removed from the tip and margins, towards the back and root of the tongue."

1527. Dupuytren deduces the opposite conclusion, from experiments made by himself, with the view of an immediate application to a case of pathology:

1528. "Il a fait dissoudre séparément, dans de l'eau, quatre substances de saveur différente, savoir du *sucre*, du *sulfate de quinine*, du *muriate de soude*, et *un acide*. Ces dispositions prises, afin que les expériences fussent concluantes, il les a commencées sur des sujets sains. Des élèves s'y sont soumis; la langue étant tenue immobile, quelques gouttes de ces sub-

stances ont été placées sur la pointe; presque aucune saveur n'a été perçue; d'où le professeur a conclu qu'elles agissaient peu sur cette partie: ensuite, la langue étant toujours tenue immobile, les corps sapides ont été placés au milieu et à la base de cet organe; les diverses saveurs ont été parfaitement senties*."

1529. *Both* these authors conclude that the *trifacial* is the nerve of taste! Dupuytren proves by experiment that the sense of taste resides at the *posterior* part of the tongue; it is well known to him that the trifacial is distributed to the *anterior* part of that organ; still he concludes that this is the nerve of taste! So difficult is it to free ourselves from preconceived opinions.

1530. These questions have been very recently taken up by Professor Panizza. The interesting paper of that physiologist is given entire in a late number of the Edinburgh Medical and Surgical Journal (vol. xiv, No. for January 1836, p. 70); and to it I must refer, briefly stating that the conclusions to which its author is led, are—1, that the sense of *taste* resides towards the base of the tongue, in the filaments of the *ninth* or glosso-pharyngeal; 2, that the sense of *touch* in the tongue resides near its point, in the filaments of the trifacial; and 3, that the *twelfth* is the true myo-glossal or motor of the tongue.

1531. The experiments of Professor Panizza appear to have been made with great care. Nor with less were those of Dr. J. Reid, who mentions, as the results of his experiments, however, that the glosso-pharyngeal "may participate with other nerves in the performance of the function of taste, but it certainly is not the spinal nerve of that sense†."

1532. M. Valentine, again, agrees with Signor Panizza‡: "Nunc postquam N. pharyngei energiam sensualem gustatoriam, quantum potuimus confirmavimus et demonstravismus," &c.

1533. An animal, in which portions of both glosso-pharyngeals had been removed, would be of constant physiological interest.

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* Leçons Orales de Clinique Chirurgicale, t. i, p. 407.

† Edinb. Med. and Surg. Journal, vol. xlix, p. 129.

‡ De Functionibus Nervosum, 1839, p. 44, &c.

1534. It will be difficult to confirm or correct these views from experiment by clinical observations. The glosso-pharyngeal is double, and if one part were compressed by a tumor or destroyed by disease, the other might still partially supply the sense of taste to the tongue.

1535. There is an interesting case, in point, however, in a note to the translation of Dr. Abercrombie's work, by M. Gendrin, (ed. 2, p. 627,) which is given in great detail, and which will be read with great interest. The nerve was atrophied by the pressure of a cyst. "La sensibilité du tact de la langue était conservée dans toute son étendue, la douleur produite par une piqûre d'aiguille était sentie sur toute la surface de sa moitié atrophiée, comme sur celle de l'autre moitié. Le froid et le chaud produisaient aussi la même sensation sur chaque moitié de cet organe. Des substances sapides, de l'hydrochlorate de soude, de l'acide acétique, de l'extrait de coloquinte, furent appliqués successivement sur chaque moitié de la langue ; ils n'occasionèrent sur la moitié atrophiée qu'une impression de saveur fort obscure, qui ne se manifesta que sept à huit minutes après leur application ; tandis que la sensation produite par l'application de ces corps se fit sentir vivement, au bout d'une minute à une minute et demie, sur la moitié non-atrophiée*."

1536. Lastly, the researches of Sir Charles Bell, M. Magendie, Prof. Müller, and Prof. Panizza, lead to the conclusion, that the *posterior* column of the spinal marrow is formed by the sentient nerves. When this column alone is disorganised, the sense of touch alone is impaired. This result is not, however, without considerable doubt.

II. *Of the Voluntary Nerves.*

1. *Paralysis.*

1537. Paralysis of the voluntary nerves is marked by loss of voluntary power over the muscles.

1538. When the third, or the oculo-motory, is diseased or compressed, we have various forms of *strabismus*, according

* Pages 629—630. Comp. Mayo's Com. No. II, p. 14.

as the infection involves more or less of its branches. Some defect of vision is frequently conjoined with it. The strabismus consists in a *defect* or *loss* of movement, which is permanent; and in this it differs from *spasmodic* strabismus, from an affection of another system of nerves.

1539. When the *minor* portion of the trifacial, or the *masticatory* nerve is paralyzed, the temporal, the masseter, and the buccinator muscles lose their voluntary powers, and eventually shrink and become emaciated. This effect exists in the case in which the *trifacial* is entirely destroyed or compressed *within* the cranium. I may here refer to a case published by Sir Charles Bell*. The patient lost the power of mastication, and of blowing a trumpet, or of smoking a pipe, on the affected side. There was no *distortion*, as in disease of the *seventh*, or facial nerve.

1540. In the list of voluntary nerves, given § 17, *part* of the *facial* should have been included. When this nerve is entirely paralyzed, the face is extremely distorted, especially in laughing, &c. and the orbicularis has lost its powers.

1541. Sir Charles Bell's work† is replete with the most spirited descriptions of the paralysis of the trifacial and of the facial pairs of nerves. But I refer my readers to his admirable work itself.

1542. Signor Bellingeri and Sir Charles Bell have run the same career of discovery in distinguishing paralysis of the *seventh* or facial nerve. The following case is copied from the former writer‡:—

1543. "A patient was lying at St. John's Hospital, under the care of Professor Geri, having been affected for a long time with an inflammatory tumor behind the right ear, which had extended both above and below the mastoid process, so as to compress the facial nerve, at its point of exit from the stylo-mastoid foramen; such was the decided opinion of the Professor, and of Drs. Gallo and Riberi. Meantime the patient presented almost entire paralysis of the muscles of the right side of the face, and distortion of the left side of the mouth. There was, in fact, complete paralysis of the frontal

* The Nervous System, 1830, p. cxiv.

† The Nervous System.

‡ See p. 181; and the Med. Chir. Review, for October 1834, p. 419.

muscle, the supraciliary, the orbicularis palpebrarum, the levator alæ nasi and labii superioris, the caninus, the zygomaticus, the right side of the orbicularis labiorum, the triangularis and quadratus menti, and colli-cutaneus. The motion of the temporal, masseter, buccinator, and pterygoid muscles, was perfect, or nearly so; of the digastricus we could form no opinion. The motion of the ball of the eye and of the upper eye-lid was free; the vision of the right eye was, however, a little injured; the tongue, also, was moved with some difficulty, yet was the taste proved to be unaffected on either side of the tongue; the sense of touch was also uninjured in the face; the hearing was considerably impaired in the right ear; the abscess had opened in the external ear. The patient died in about two months. An effusion of pus was found in the cavity of the tympanum, contained in the aqueduct of Fallopius, and compressing the facial nerve in its course; there was no pus or trace of inflammation about the stylo-mastoid foramen after death; but marks of recent inflammation and suppuration in the right lobe of the cerebellum; the fibres and trunk of the trifacial were uninjured."

1544. I have already noticed, § 149, the *partial* paralysis of the *facial* nerve in hemiplegia: the *voluntary* portion is paralyzed; the fibres which belong to the excito-motory system, § 251, are unaffected; the eye-lid is closed by its sphincter, the orbicularis, during sleep. In *total* paralysis of the *facial* from the pressure of a tumor, for instance, the orbicularis loses its power, and the eye remains exposed and becomes inflamed. The inference from these facts is, that the *facial* is *more* than a cerebral nerve. Indeed, the function of the orbicularis, in sleep, so similar to that of the other sphincters, leads to the same conclusion. The question still, however, requires elucidation.

1545. I now come to the *twelfth* nerve, or the myo-glossal. Dupuytren gives a most interesting account of a case supposed to be paralysis of this nerve*:—

1546. There were rheumatism of the neck, situated along the vertebræ and occiput; and the gradual loss of muscular power, with atrophy of one half of the tongue, the sense of

* Leçons Orales, t. i, p. 403.

taste towards the base of the tongue remaining entire. The myo-glossal nerve is supposed to have been involved in the disease at and after its exit from the cranium; hence the affection of the tongue. The scarificator and cupping glasses were repeatedly applied behind the mastoid processes, with satisfactory results.

1547. After the myo-glossal, I must briefly allude to paralysis of the *anterior* spinal nerves, or *prolongations* of cerebral voluntary nerves *within* the spine.

1548. In the Journal de Physiologie of M. Magendie, t. vi, p. 138, there is a case by M. Velpeau tending to prove the difference of function of the posterior and anterior spinal nerves. M. Velpeau observes, in conclusion—" la distinction sur les fonctions diverses des racines nerveuses, distinction rendue si évidente par les expériences sur les animaux, est encore fort obscure quand on cherche à la juger par les faits pathologiques; néanmoins l'observation renfermée dans cette note est la plus concluante qui ait été remarquée en faveur de cette opinion."

1549. But the most interesting case of this kind, is one quite recently depicted and published by Sir Charles Bell, in the Philosophical Transactions, for 1840, p. 246.

1550. " Plate IX exhibits a tumor which engaged the *anterior* roots of the several nerves as they form the *cauda equina* within the tube of the vertebræ. The tumor was of the form of an almond, but larger, and into it the *motor* roots, both of the right and left side, were gathered, whilst the *sensitive* roots were free." " The lower extremities were deprived of motion, whilst they retained sensibility, and symptoms of so much interest were noted and discussed by the physicians and pupils."

1551. In every case of spinal affection, it will be interesting to determine the degree in which the sentient and motor columns and nerves are involved in the disease. The question of the sensitive and motor character of the anterior and posterior *columns* is still involved in great obscurity.

2. *Spasm.*

1552. I have hitherto treated of paralysis of the cerebral sentient and motor nerves; I must now have drawn at-

tention to certain spasmodic affections of the latter of these, if I had not my doubts whether the *cerebral* nerves, as distinguished from the *true spinal*, were ever affected with spasm. This mere doubt will suggest an inquiry of the deepest interest, both in physiology and pathology.

1553. The substance of the brain*; the olfactory nerves; the retina, the optic nerve; the auditory nerve†; the glosso-pharyngeal‡, are *insensible* and *inexcitor*|| when wounded or pinched. Wounds of these do not induce spasmodic contraction. No experiment has hitherto been made upon any purely *cerebral* voluntary nerve, with the view of determining whether, in such a case, there would be spasmodic action. Perhaps such a nerve does not exist entirely free from the intermixture of *true spinal* filaments. Is the levator palpebræ of this character? These, with many other questions, are still left for future inquiry,—by experiment and observation.

1554. If this treatise had no other value, that of the nu erous suggestions for new investigation *must* prove exceedingly great.

Section II.—*Of the Diseases of the True Spinal System.*

1555. It is utterly impossible to understand the diseases of the spinal marrow without a constant reference to its peculiar functions, as distinguished from those of the cerebrum. I must refer my readers to the observations which I have made in previous sections upon this distinction.

1556. Such diseases of the spinal marrow as may materially affect its functions, induce, in the first place, paralysis of the cerebral nerves, sentient and voluntary, which run along its course, forming a part of its structure; and, in the second, either an excited or paralysed condition of its own peculiar functions. The symptoms combine, therefore, paralysis of sensation and voluntary motion, in parts below the disease,

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* Flourens, Recherches sur le Système Nerveux, p. 17.

† Magendie, Journ. de Physique, t. v, p. 38.

‡ Panizza, Edinb. Med. and Surg. Journ. vol. xlv, p. 86.

|| The optic *excites* contraction of the *iris*.

with spasm and ultimately paralysis, resulting from the affection of the *true* spinal marrow. I have spoken of the anatomy, and of the physiology; from these we may *deduce* the symptoms.

1557. In treating of the diseases of the spinal marrow, I shall pursue the following order. I shall notice,—

I. *The Central Diseases, or Diseases of the True Spinal Marrow itself.*

II. *The Centripetal Diseases, or Diseases excited through the Excitor Nerves.*

III. *The Centrifugal Diseases, or Diseases of the Motor Nerves.*

1558. In designating them, I have borrowed terms used by Professor Müller, in reference to physiological actions.

1559. I begin with the *central* diseases. Of these diseases the first is—

I. *Inflammation within the Spine;*

and this, like encephalitis, § 1309, is to be distinguished into—

1. *Inflammation of the Membranes, or Spinal Meningitis.*
2. *Inflammation of the Substance, or Spinal Myelitis.*
    1. *Of the Cerebral, or Sentient and Voluntary Tracts.*
    2. *Of the True Medulla;* and
    3. *Of its Principal Divisions.*

1560. *The causes* of inflammation within the spine are, principally, blows or falls, violent muscular efforts, and exposure to damp or cold. One patient became affected with acute spinal myelitis from being long exposed to the rain and cold in an open boat. This affection has frequently occurred from the pernicious custom of lying upon the damp grass. Rheumatism seems occasionally to have led to this disease. The observations of M. Louis have distinctly shown the connection between caries of the vertebræ and spinal myelitis.

1561. *The symptoms.*—It is rare that meningitis of the spine exists without meningitis within the cranium. It is equally rare for the membranes to be inflamed, or one of the cerebral tracts, without affection of the substance, or of the other portions of the spinal marrow. The distinctions between these affections are not, therefore, easily defined.

Happily they are not essential to the treatment. Those symptoms which point to such distinctions will be noticed, however, as we proceed.

1562. A much more interesting distinction arises from the various locality of the inflammation, according as it affects the medulla oblongata, or the cervical, dorsal, lumbar, and sacral portions of the spinal marrow. A knowledge of the anatomy and physiology frequently enables us to define the region of the spinal marrow which is the seat of the disease, and guides us at once in our prognosis, and in the local application of remedies, the most important part of the treatment.

1563. In general, the symptoms of meningitis are *more* those of *irritation* of the spinal marrow, or *spasm;* those of *myelitis, more* those of *destruction* of the organ, or paralysis. Both kinds of symptoms may exist, however, or follow each other, in both diseases. See particularly § 1385—.

1564. Diseases, especially those of the nervous system, are usually more complicated in individual patients, than as they are described in books. Hence a difficulty in the commencement of practice. We are led to expect impossibilities—diseases well defined in their simple forms. It will be well for us, in reference to our present subject especially, to become well acquainted with the anatomy and the physiology, and we shall then be able to interpret each symptom justly as it appears.

1565. Amongst the first symptoms of spinal *meningitis* is local *pain* in some part of the spinal column, augmented by the movements of the patient, and by percussion, but rarely, if ever, by pressure along the spine. This pain sometimes extends along the back and limbs, in which there is then tenderness on pressure,—a symptom which may serve to distinguish meningitis from myelitis, in which there is usually loss of sensibility.

1566. The next important symptom is spasm, or various kinds of muscular contraction. The head, the neck, or the trunk is bent backwards, or there is trismus, torticollis, partial or complete opisthotonos, or contraction of the limbs,—constant, or recurrent, or exacerbated, in paroxysms, on moving, on being moved, &c. with extreme pain; sometimes there are convulsions.

1567. The respiration is sometimes difficult. There is sometimes retention of urine and constipation.

1568. The symptoms will vary according as the meningitis exists at the base of the brain, at the upper, or at the lower, part of the spine principally.

1569. The symptoms of spinal *myelitis* are those of paralysis of sensation and voluntary motion; a sense of numbness, an impaired sensibility, a sense of feebleness, an impaired muscular power, are first observed, singly or combined, in one or both of the inferior or superior extremities.

1570. In some cases, probably of complication with meningitis, there is augmented sensibility. In other cases there are spasmodic or convulsive affections.

1571. If the disease proceeds, the paralysis of sensation and voluntary motion gradually augments. Generally the paralysis affects first the inferior, and afterwards the superior extremities; far more rarely it pursues a contrary course: occasionally the motions alone, and very rarely the sensations alone, are paralysed. See p. 223, *note*.

1572. If the disease occupy the *upper* parts of the spinal marrow, the respiration, and even the action of the larynx and pharynx become impaired, and we have difficulty or choking in swallowing, or asphyxia. There is sometimes the sensation of a cord-like tightness across the epigastrium. If the *lower* part of the spine be affected, the bladder, the rectum, and their sphincters, are variously paralysed, and there may be retention of urine and constipation, or involuntary evacuations, or retention and involuntary flow of urine may be combined. The condition of the bladder and the condition of the rectum should be ascertained by proper examinations, *in every case*.

1573. In some instances there is perfect impotence, or inertia of the uterus: in others the patient has become a father, or the uterus has been excited to expel the fœtus. On these points I must refer to the observations of MM. Chaussier, Serres, Brachet, &c. See § 333; 336; &c.

1574. These differences, doubtless, admit of explanation by a reference to the *kind* of affection,—irritation, or destruction, and its *locality*,—in the cervical, dorsal, or lumbar portions of the spinal marrow. See p. 268, especially.

1575. My readers will find a valuable case of uncomplicated

spinal *meningitis*, considered by M. Cruveilhier as affording a type of that disease, by M. Dance, in M. Ollivier's work, p. 551. In M. Louis' admirable "Memoirs," there is an interesting paper on the condition of the spinal marrow in caries of the vertebræ, in which my readers will learn the symptoms and morbid changes in *myelitis*,—p. 410; and especially pp. 445—447:

1576. "Ainsi, tout en offrant la même lésion de la moelle épinière, les deuxième, troisième et quatrième observations nous ont présenté des symptômes différens. Dans la première, douleurs dans la région de l'épine, roideur, faiblesse, quelquefois mouvemens spasmodiques des membres inférieurs: dans la seconde, mêmes douleurs, puis paralysie des mêmes parties, rarement interrompue par quelques mouvemens convulsifs; et dans la troisième, encore des douleurs dans la région indiquée, unies à une faiblesse dont rien ne pouvait rendre compte pendant la vie, sans paralysie ni roideur des membres abdominaux:" p. 44.

1577. *The morbid anatomy* is in every respect similar to that of cerebral meningitis and myelitis. It is rare, indeed, that spinal meningitis occurs without a similar affection of the membranes of the brain. Injection of the pia mater, and of the spinal vessels in general, effusion of serum, lymph, pus, and blood, under the arachnoid, diffused or in portions; perhaps softening of the adjacent medulla. The arachnoid itself is free from blood-vessels; the morbid changes supposed to take place in this membrane have their seat in the subjacent cellular membrane, or in the pia mater.

1578. In *chronic* meningitis there are sometimes membranous adhesions and effusion of a cartilaginous hardness.

1579. The principal morbid change in myelitis is softening, which may occupy the whole, or any portion, either side, or the anterior or posterior part of the spinal marrow; it most frequently affects the cervical or lumbar portions. There is, as in the same affection of the brain, a degree of tumefaction. Induration is the frequent result of *chronic* myelitis.

1580. The most efficacious *treatment* of inflammation within the spine, consists, I believe, in the application of cupping in acute cases, and of issues and setons in the chronic.

1581. Cupping may be applied so as to involve the two

principles of local depletion and counter-irritation; for this purpose, the scarification should be applied deeply and crossed, and little blood should be drawn, the operation being repeated according to the violence of the disease and the powers of the patient.

1582. In reference to the use of issues, M. Louis makes a very apposite remark:—"Experience has demonstrated the utility of issues in Pott's disease, when that affection is of long standing, and voluntary movement more or less injured. A necessary consequence of the foregoing is, that the same means ought to be employed in the simple or primitive softening of the spinal marrow."

1583. The administration of mercury in the acute cases, and in the chronic cases when these are uncomplicated with a tuberculous diathesis, is an important measure.

1584. The most moderate diet should be enjoined, the bowels should be kept free; the recumbent posture, with the utmost quiet, should be preserved.—For further suggestions for the treatment, I may refer to what I have said upon the treatment of encephalitis (§ 1329).

II. *Congestion; Hæmorrhagy.*

1585. I believe that little can be said of these forms of spinal disease. If they can ever be suspected during life, it can only be from the suddenness of the accession or attack of the symptoms; and the treatment must be the same as in acute inflammation within the spine.

1586. In the case portrayed, *Plate* VIII, *fig.* 5, the medulla oblongata being *suddenly* compressed, the respiration ceased, and the patient expired instantly. I am indebted for this interesting case to Mr. Kiernan. An organic change, which would have produced irritation rather than pressure, would have induced a very different effect.

III. *Centric Convulsions, or Epilepsy.*

1587. *Any* disease within the cranium or spine, whether effusion, tumor, exostosis, &c. may induce convulsions or epilepsy.

1588. Fright, or other sudden mental emotion, has induced convulsion, and this convulsion has been repeated, affording one of the most deplorable cases of epilepsy.

1589. I have already suggested, indeed, that *all* convulsive diseases are affections of the true spinal marrow. I refer my readers to the observations made § 188; &c.

1590. The cerebrum is obviously the seat of the mind; it is neither sentient itself, nor the originator of motions in itself.

1591. The true spinal marrow, on the contrary, is the term of certain excitements and the combiner of certain motions; the centre, in a word, of a peculiar series of excito-motory phenomena, physiological and pathological. Unlike the cerebrum, it induces, if stimulated, convulsive movements in the organs appropriated to ingestion and egestion, and in the limbs.

1592. Diseases within the cranium, by irritating excitor nerves, or the medulla oblongata, induce convulsions or epilepsy,—too frequently, alas, of an incurable character.

1593. Disease within the spinal canal may prove the source of convulsion or epilepsy, still more immediately. This form of epilepsy is also, for the most part, incurable.

1594. These cases are, for obvious reasons, frequently met with in hospitals, asylums, and workhouses.

1595. Hence the idea that epilepsy is not to be subdued by medicine, prevalent amongst those who draw their conclusions from observations made in these establishments.

IV. *Paralysis agitans.*

1596. I must now draw my readers' attention, very briefly, to another disease of the spinal marrow, the paralysis agitans. Its symptoms have been well described by Mr. Parkinson; but its morbid anatomy has not been traced. It is usually a disease of advanced life.

1597. Paralysis agitans is either—

1. *General*, or
2. *Hemiplegic.*

1598. The first symptom of this *insidious* disease is weakness and tremor,—of the head, for instance, the hand, &c. In about a year, the other hand, or a lower extremity, is

affected, or the patient loses his balance in walking. Generally no *cause* can be assigned.

1599. There is perpetual tremor, even when the part is supported; the head, the hand, the leg, are moved incessantly; reading and writing become impossible; and the patient cannot guide his hand to his mouth: at length he loses his balance, and there is a constant tendency to fall forwards, and, in order to avoid this, to run or move with a quicker pace, and on the toes.

1600. At a later period, the tremor continues during sleep even, augmenting until the patient awakes. There is increased weakness, the trunk is bent forwards, the upright position can no longer be supported; the articulation becomes indistinct, mastication and swallowing imperfect; the bowels are all along torpid, then obstinate; at last, the urine and fæces are passed involuntarily. In the last stage of all, there is slight delirium, or lethargy.

1601. The symptoms have, in several particulars, a marked resemblance to the effects observed by M. Serres of diseases of the *tuber annulare*, and of the *tubercula quadrigemina*.

1602. Of the hemiplegic paralysis agitans, I have long had an interesting case under my care:—

1603. — Macleod, aged twenty-eight, is affected by weakness and agitation of the right arm and leg, augmented on any occasion of agitation, and on moving; it is observed as he walks, or when he passes his cane from one hand to the other; there is, besides, a peculiar lateral rocking motion of the eyes, and a degree of stammering and defective articulation.

1604. Nearly allied to paralysis agitans is the

V. *Tremor Mercurialis.*

1605. This disease affects workers in mercury, chiefly those occupied in silvering mirrors.

1606. The symptoms are, at first, paralytic tremor and debility, and perhaps ptyalism; afterwards, convulsive agitation of the limbs whenever they are moved; the articulation becomes imperfect; the hands are so agitated that a partly

filled cup cannot be conveyed to the mouth* without spilling the liquid. On attempting to walk, the limbs dance and perform irregular movements: whilst sitting still, the patient may remain free from chorea; but on every act or exertion of volition, and on every occasion of mental agitation, the irregular movements are renewed. The sleep is disturbed, the patient awakes alarmed by terrific dreams; there are nervousness and debility; the bowels are constipated.

II.—*Of the Centripetal Diseases.*

1607. I now proceed to treat of those diseases of the true spinal system which originate at a distance from the spinal centres; and

I. *Of Centripetal Epilepsy.*

1608. This form of epilepsy takes its origin in the *excitor nerves* of the true spinal system, involving the axis of this system, and its motor nerves, in their turn; functionally, however, not organically. It is for this reason that I have denominated this form of epilepsy *centripetal.*

1609. This form of epilepsy is to be viewed as *curable,* however *difficult* of cure. By avoiding the exciting causes, its attacks are avoided; the susceptibility to returns subsides; these returns become less frequent and less severe, and at length frequently cease altogether. Every thing depends upon rigid rules proposed by the physician, and *most strictly and perseveringly* observed by the patient.

1610. In describing the *causes, symptoms,* and *treatment,* of centripetal epilepsy, I must refer to all that I have said respecting the anatomy and physiology of the truespinal system. *Every* part of this system is distinctly but exclusively involved in the circumstances of this disease; if the encephalon suffer, it is only as an *effect* of the convulsive attacks.

* In a letter written from Venice by the learned Dr. Walter Pope, on the miners of mercury in Friuli, and published in the Philosophical Transactions, vol. i, for 1665, a case is detailed of a patient who "could not, with both hands, carry a glass half full of wine without spilling it, though he loved it too well to throw it away."

1611. The principal causes of eccentric epilepsy are—1, the presence of indigestible food in the *stomach;* 2, the presence of morbid matters in the *intestines;* 3, *uterine* irritation. The first of these acts through the medium of the pneumogastric; the second and third through that of peculiar spinal nerves,—all *excitors* belonging to the true spinal system.

1612. I have so repeatedly known a patient, subject to this form of epilepsy, experience an attack within a few hours after eating some indigestible article of food; or on experiencing a deranged condition of the bowels; or on every return of the catamenial period, as to leave no doubt upon my mind upon these important points. I have known the attacks prevented by a steady and cautious attention to rules in reference to these circumstances.

1613. In detailing the *symptoms* of epilepsy, I shall have to repeat all that I have said respecting the physiology of the true spinal system; every part, every function, which belongs to that system, is involved in the pathology of epilepsy; the functions of ingestion and of egestion are precisely those affected in this disease; the *causes* act through the *excitor* nerves, the *symptoms* are manifested through the *motor* nerves of that system.

1614. The first thing observed in the severe forms of this fearful malady is a varied *distortion of the eye-ball,* which is drawn from the axis of vision generally upwards, and outwards, or inwards, and of the *features.* The second symptom is a forcible closure of the *larynx,* and *expiratory efforts,* which suffuse the countenance, and, probably, congest the brain with venous blood. In all these circumstances there is a most marked and important difference between epilepsy and hysteria, on which I shall insist hereafter.

1615. In the third place, we observe that the tongue is thrust out of the mouth by the genio-glossal muscle, whilst the teeth close upon it by the action of the masseters, and it, or the upper lip, is frequently severely bitten; or, without the spasmodic protrusion, and consequent injury of the tongue, there is grinding and even dislocation of the teeth.

1616. We next observe convulsion,—which is general, or of the whole muscular system, or hemiplegic, or confined to

one side; or it occurs in the form of trismus, torticollis, in one arm, one limb, &c.

1617. During these attacks, the *expulsors* of the fæces, the urine, or the semen, sometimes act, and there is the unconscious evacuations of these secretions. There is sometimes rigidity of the penis. On this subject I must refer particularly to what I have said, § 485.

1618. My readers will see, from this brief account of the symptoms, how peculiarly epilepsy is an affection of the true spinal or excito-motory system The previous arrangement of the functions of the system in their mind, will enable them to remember and to explore the symptoms of this disease most accurately.

1619. The *principal* features of this disease are represented in the following

TABLE OF EPILEPSY.

I. *The Excitors.*	II. *The Centre.*	III. *The Motors.*
1. *The Pneumogastric in the Stomach.*	*The Medulla Oblongata.*	1. *The Recurrent of the Pneumogastric, closing the Larynx.*
2. *The Spinal in*		2. *The Spinal, inducing*
1. *The Intestine.*		1. *Forcible Expirations.*
2. *The Uterus.*		2. *Convulsion.*
		3. *Expulsion of the Urine, &c.*

1620. I must now draw my reader's attention to another set of *facts*, as *causes*, and also to another set of *symptoms*, as *effects*, of the paroxysm.

1621. Deep sleep, broken sleep, loss of rest, passion, vexation, exhaustion, inanition, and especially rising with an empty stomach, have frequently led to a paroxysm of epilepsy, and must, consequently, be carefully avoided in our rules of regimen for the cure of this disease. I have alluded to the relation of the συνωσια and epilepsy.

1622. I have known the act of washing the hands in cold water induce an attack of epilepsy; I have known dashing

cold water on the face prevent such an attack. These phenomena must be observed with accuracy.

1623. The *effects* of the epileptic paroxysm, to which I have just alluded, are the venous congestion of the brain, and the consequent effusion of serum, in repeated attacks—effects carefully to be avoided by the appropriate remedies, on account of the havoc produced by them on the mental faculties and cerebral functions.

1624. Our task consists in preventing the attacks of epilepsy, and, if this cannot be accomplished, in treating these attacks, and in obviating their effects on the *cerebral* system. We accomplish this task by cautiously avoiding the *causes*, by moderating the *paroxysms*, and by local means of subduing vascular fulness.

1625. The strictest rules must be laid down for the diet, for the state of the bowels, for conducting the catamenial periods. These last should be passed in bed; the feet and abdomen should be fomented; the warm-water enema, warmer than usual, and the opiate enema, should be administered.

1626. The immediate accession of the paroxysm may sometimes be prevented by dashing cold water on the face, or by exciting the nostrils by snuff, &c. In this manner the disposition to closure of the larynx, and expiratory efforts, is exchanged for sudden acts of inspiration. Or the fauces must be irritated, or an efficient emetic be given.

1627. In the paroxysm, the patient must be prevented from injuring himself by falls or blows. In this danger of injury we have another marked distinction between epilepsy and hysteria.

1628. The stupor, or coma, induced by the paroxysm, may require the administration of bloodletting, general or topical, according to its degree and deviation, and probable effects. But *tracheotomy* is the remedy against the stupor, or coma, following the attack of epilepsy, if it exist in an *extreme* degree. (See § 1366—.)

1629. Besides the means to which I have alluded, other remedies have been proposed for the cure of epilepsy, in an empirical manner, without due attention to the *kind* of the disease. It is obvious that little attention can be paid to pro-

positions and observations so vague and indefinite. These various remedies must be tried anew, after a strict diagnosis. We shall then arrive at an approximation to the truth in reference to the value of these remedies respectively.

1630. The views which I have given of centripetal epilepsy are amply confirmed by the facts, that there is no constant morbid change observable in this disease, and that many patients, after long years of its attacks, have finally and fully recovered; facts which ought to encourage us steadily to pursue the mode of treatment.

1631. In reference to the treatment of epilepsy, I must repeat that the stomach must be kept constantly free from irritation by the strictest attention to diet; the bowels, by efficient, daily, stomachic aperients; whilst the nervous system is quieted by the hyoscyamus; that the digestive, muscular, and general systems must be invigorated by regular exercise, early hours, &c.

1632. The sleep should never be disturbed. It should also never be heavy; and, with this object, supper should be carefully avoided.

1633. If there be the threatening of an attack, an ipecacuanha emetic, an enema of three or four pints of warm water, and a decided, mild, purgative medicine, should be given as quickly as possible. The emetic is doubly proper, by freeing the stomach, and inducing a new kind of action of the true spinal system.

1634. A system of exercise, regulated sleep, the shower bath, tonic remedies, &c. &c. must be added to the other plans.

1635. After this plain and practical view of the subject, I wish to draw my readers' attention to a few other points of intense interest in reference to epilepsy.

1636. Sometimes the attack *consists* in a momentary loss of consciousness, "oblivium quoddam et delirium adeo breve, ut fere ad se redeat, priusquam ab adstantibus animadvertatur*." Sometimes this oblivium *precedes* the attack of con-

* Heberdeni Comment. cap. 33.

vulsion. What are the *cause* and *nature* of this momentary loss of consciousness?

1637. In one case, the patient frequently experienced a peculiar slight alteration in the *voice, before* the attacks, nay, many hours before the attacks. In another case the patient lost the power of singing certain high notes, which he could easily accomplish before, *after* each attack. A spasmodic affection of the larynx has obviously much to do in this disease, as well as in the crowing inspiration or croup-like convulsions of infants; so much, indeed, that I doubt whether *convulsion* could occur without closure of this organ. Convulsion is frequently prevented for hours together by continuously watching the threatenings of it, and dashing cold water on the face. Now the action of cold water upon the trifacial nerve, effects, by a reflex influence, the opening of the larynx, and an act of inspiration, and thus prevents the series of muscular actions which constitute convulsion; viz. closure of the larynx, forcible efforts of expiration, and general spasmodic contraction of the muscles. It is a singular idea, that *tracheotomy would probably prevent the epileptic convulsion.*

1638. Does such a spasmodic action take place in the *muscles of the neck* unnoticed, compress the veins which convey the blood from the brain, and induce the *oblivion* to which I have just alluded?

1639. But there are two distinct *forms* or *degrees* of epilepsy: in the severer form, the tongue or lip is bitten, the larynx is closed and violent efforts of expiration made, and some excretion, the urine, fæces, or semen, is expelled; and the attack is followed by coma, or oblivion of proportionate severity and duration: in the less severe form, these events do not occur. It frequently happens, as the *cure* is effected, that the paroxysms become less frequent, or gradually pass from the severer to the less severe forms, and at length cease altogether.

1640. There is a similar, most important difference between epilepsy and hysteria. The former is amongst the most serious and intractable of diseases; the latter is comparatively of little consequence. What is the cause, the nature of this difference? Certainly, amongst other circumstances, that of

the presence of closure of the larynx in epilepsy, and its absence in hysteria, is not the least important. It is this event in epilepsy, combined with the expiratory struggles, which fills the veins, and induces congestion of the nervous centres, with its terrific effects. It is the absence of these phenomena in hysteria which is the cause of the little damage done to the nervous centres in this disease, even when most violent. Consciousness is obliterated in the former disease, but is only partially, if at all, impaired in the latter. Convulsions occur in their most frightful form in epilepsy. I know not whether to call the violent movements in hysteria convulsions. What an important topic for investigation!

1641. I *must* add another remark. Compare the croup-like affection of infants,—a *laryngal* affection, with *pertussis*, —a *bronchial* affection. The former readily passes into convulsion; the latter rarely, and then only from the same cause, viz. the violence of the expiratory efforts. Again I say, how much remains for fresh investigation. Compare the croup-like affection with asthma in adults; the former is a *laryngal*, the latter a *bronchial asthma;* the former passes into convulsion, the latter *never*.

1642. These observations are made in order to excite attention to this subject. The space allotted to it here does not allow me to do more than give a mere sketch of the important inquiry in which I am engaged.

1643. Either as *cause* or *effect* of the epileptic seizure, the fæces are deficient in bile, and the urine is preternatural in quantity and appearance, being, in one case, profuse before, and turbid, with lithic deposits, after the attacks.

Similarity of Epilepsy and Strangulation.

1644. Before I quit the subject of epilepsy, I must make one remark—upon the similarity of its effects to those of *strangulation*. In *both* these cases, there is suspended respiration, with convulsive efforts, congestion of the brain, insensibility; and, to complete the analogy, amongst the remote *effects* of strangulation, is convulsion itself, the tongue is protruded, the semen expelled. I may refer to an interesting case in the

"Observations on Surgery," by the late Mr. Hey, of Leeds, ed. 4, p. 481. To shew how much a *guide* is wanted to teach us what to observe, I may mention that Mr. Hey does not once refer to the condition of the respiration in his patient.

1645. That the convulsions in strangulation may be *excited* through the medium of the pneumogastric nerves, is rendered almost certain by comparing the effects of the privation of air in animals in which these nerves are left entire, and in others in which they are divided; the former *with*, the other *without*, convulsions.

1646. The effects of pinching the pneumogastric in a living animal may be adduced in confirmation of these views. The pneumogastric is obviously an *excitor*, as well as a motor and ganglionic nerve.

1647. But if we compare strangulation with drowning, we must be convinced that much depends upon the condition of the circulation within the cranium by the tightened cord. In drowning, there is no protrusion of the tongue, no escape of fæces or semen. In strangulation, every thing denotes an immediate affection of the central part of the true spinal system, which *now becomes* the *primum mobile* (compare § 599) of the phenomena. This view of the subject is confirmed by the experiments of Sir A. Cooper: see § 430.

1648. But, even in drowning, some of the phenomena are, I think, of the same character. The *gasping* observed during drowning is similar to the *gasping* of the decapitated head. Now, in the latter case, the influence of the pneumogastric is removed. But I doubt whether this act of gasping can be regarded as *re*spiratory: in drowning, it is associated, not with an effort of *in*spiration, but of *ex*piration, with the evident contraction of the abdominal muscles, and expulsion of numerous bubbles of air from the lungs. But this subject, like so many others, must be elucidated by new experiments.

1649. My readers will remember what I said on the subject of *secondary asphyxia*. The remedy is—frequent, full inspirations, entirely to remove residuary carbonic acid in the lungs, repeated until the danger is over. It has been observed, that convulsive diseases occur in infants, especially during the sleep. In this state there is a *defective* respiration; the proportion of carbonic acid in the lungs is greater than in

waking hours. May this be an exciting cause of the convulsions? If so, the remedy would be to excite respiration by gently disturbing the sleep, after the lapse of a certain time.

1650. I scarcely dare touch upon the phenomena presented by the generative system during strangulation by suspension. It is well known that those organs are excited, and that there are erection and emission of semen, in the male subject, and a uterine flow in the female. It is said that a recourse to a temporary suspension has been had by the sensualist. It is said that in this manner an unintentional suicide has been committed.

II. *Puerperal Convulsion.*

1651. Nearly allied to epilepsy is puerperal convulsion.

1652. I have no doubt that the mysterious phenomena of abortion and parturition are phenomena of the true spinal or excito-motory system. The same remark may be made relative to the sickness and vomiting attendant on early pregnancy. To the same class of phenomena, also, belong the convulsions which occur in the *pregnant* and *parturient* states.

1653. The principal *causes* of puerperal convulsion, besides the peculiar condition of the uterus itself, are indigestible food, a loaded and morbid state of the bowels, a distended condition of the bladder, &c. mental shock, or anxiety; muscular effort; hæmorrhagy; &c.

1654. This convulsion itself resembles epilepsy. It is preceded by a peculiar hissing inspiration. It is attended with great danger, the coma induced by it being deep, and the cerebrum obviously much affected.

1655. The following extracts from Dr. Denman's work on Midwifery are full of interest in reference to an exciting cause, and a mode of prevention, of this species of convulsion:

1656. "In a case published twenty-three years ago, when the os internum began to dilate, I gently assisted during every fit; but being soon convinced that this endeavour brought on, continued, or increased the convulsions, I desisted, and left the work to Nature."

1657. "On every principle of removing the cause of the convulsions, of substituting new modes of irritation, different from that which produced the convulsions, of preventing

their ill effects, or of abating that exquisite irritability which renders patients subject to them, almost every measure and method has at one time or other been tried. *Harvey* recommended the irritation of the nose in a comatose patient, who was in labour, and gives an instance of its success. Many years ago, I was led, by accident, to try the effect of sprinkling or dashing cold water in the face; and in some cases the benefit was beyond expectation or belief; but in other cases in which I used this method, with equal care and assiduity, no good whatever was derived from it.

1658. "I subjoin the following case, to explain the manner of using cold water. In a patient in convulsions, who had been bled, and for whom many other means had been fruitlessly used, I determined to try the effect of cold water. I sat down by the bedside, with a large basin before me, and a bunch of feathers. She had a writhing of the body, and other indications of pain, evidently occasioned by the action of the *uterus*, before the convulsions; and when those came on, I dashed, with some force, the cold water in her face repeatedly, and prevented the convulsion. The effect was astonishing to the by-standers, and, indeed, to myself. On the return of the indications of pain, I renewed the use of the cold water, and with equal success, and proceeded in this manner till the patient was delivered, which she was without any more convulsions, except once, when the water was neglected. The child was born living about fifteen hours from the time of my being called, and the patient recovered perfectly.

1659. "I was much mortified to find that I had not discovered a certain and safe method of treating convulsions; further experience convinced me that this often failed. It is, however, a safe remedy; and though it may not always have sufficient efficacy to prevent or check convulsions, whoever tries this manner of using cold water will soon be convinced that it is a most powerful stimulant."

1660. *The* remedy is the most efficient bloodletting, and the removal of the causes. Dr. Denman observes:—"The late Dr. Bromfield informed me of a case of puerperal convulsions, for which he had bled the patient without much benefit. In the violence of some of her struggles, the orifice

opened, and a considerable quantity of blood was lost before the accident was discovered; but the convulsions from that time ceased." Of another patient he observes:—"She fell into labour; she became blind, and had one convulsion. Having great sickness at her stomach, without vomiting, I urged her to irritate her throat with her finger, by which means she vomited five or six times, and had no fit afterwards; the blindness remained in some measure for several days after delivery. The child had been dead about a fortnight." The bladder, the rectum, should be evacuated.

III. *On Tetanus.*

1661. Tetanus has long been divided into the idiopathic and the traumatic. I propose to divide it into the *central* and the *centripetal.*

1662. Central tetanus is that produced by disease within the spinal canal itself. Centripetal tetanus arises principally from a wounded, lacerated, or punctured nerve, and possibly from other sources of eccentric nervous and convulsive affection, as deranged stomach, deranged bowels, worms, &c. It is, therefore, both traumatic and idiopathic.

1663. There is a predisposition to tetanic affection in hot climates; sudden changes of temperature, and exposure to cold and damp, are exciting causes. In hot climates, infants are subject to tetanus within nine days of their birth, as some have supposed, from the condition of the umbilicus.

1664. The spasms first affect the muscles about the neck; then those which approximate the maxillæ, and there is trismus; then the muscles of the pharynx, and the deglutition becomes difficult. The limbs and the whole frame become stiffened by spasm, which is still further augmented by the slightest touch, jar, or excitement. There is constipation. No one can fail to see that these are affections of the true spinal system. The cerebral system is unaffected. Baron Larrey observes*:—"Les fonctions du cerveau restent intactes jusqu'au dernier moment de la vie, en sorte que l'infortuné atteint de cette maladie se voit mourir."

1665. One fact is observable. The influence of the lesion

* Mémoirs du Chirurgie Militaire, t. i, p. 238.

of the nerve is not only carried by excitor nerves to the spinal axis, and *reflected* upon motor nerves, but it frequently pursues a *retrograde* course along the spinal marrow; a wound of the foot, not less than a wound of the hand, leads to trismus. A similar event occurs in experiments on the decapitated turtle. If one of the lateral nerves be laid bare, and pinched continuously, the muscles of the upper extremities, as well as the lower, are forcibly contracted. This is, in my mind, the very *type of tetanus*. The same retrograde action is produced, if, in a decapitated frog, the spine be divided, and the lower end of the upper portion of the spinal marrow be pinched with the forceps. See § 206—.

1666. As in epilepsy, no constant morbid appearances have been found in the cranium or spinal canal.

1667. In an interesting case of tetanus, given by Dr. Reid, in the "Transactions of the Association of Physicians in Ireland," vol. i, p. 113, great vascularity and an effusion of blood were found round the spinal marrow. In another case, detailed by Mr. Brayne, of Banbury, in the "London Medical Repository," vol. xiv, p. 1, two or three inches of the inferior dorsal portion of the spinal marrow were suffused by a continuous blush of inflammation; and three small, hard, white laminæ were seen between the arachnoid and pia mater. M. Ollivier, on the other hand, shows that such morbid appearances are by no means constant; Dr. Abercrombie and M. Gendrin come to a similar conclusion.

1668. The treatment of tetanus is generally unavailing. Considering the cause of this malady, and its mode of operation, we should be naturally led to propose the division of the injured nerve, or amputation. There is a successful case of the former operation in the "Medical Gazette," vol. xi, for 1832-3, p. 623. In reference to the latter, Baron Larrey observes, in his "Account of the Campaign in Russia*,"—"A l'exception d'un seul, tous ceux qui furent frappés de cette cruelle maladie succombèrent. Ce premier, blessé au pied, du son salut à l'amputation de la jambe, faite dès l'invasion des premiers accidens tétaniques. Les extirpations du bras et les amputations des jambes furent généralement heureuses."

* Mémoirs de Chirurgie Militaire, t. iv, p. 168.

These plans have not succeeded in the hands of other surgeons, perhaps from being adopted too late.

1669. I wish I had space for M. Dupuytren's admirable observations in his "Leçons Orales, t. ii, p. 599—612; they are full of interest. He advises that half-divided nerves should be completely divided. He is opposed to amputation as inefficacious when tetanus has actually commenced. He adds, "Du reste, les symptômes et l'autopsie se réunissent pour démontrer que le tétanus est une affection essentielle, nerveuse et sans lésion organique qui lui soit propre."

1670. Bloodletting, opium, the hydrocyanic acid, tobacco, mercury, antimony, local depletion, purgative medicines, have been tried, with but occasional success. The cold bath has proved immediately fatal.

1671. The *principles* of treatment would appear to be —1, to divide the injured nerve; 2, to subdue the spasmodic affections by such remedies as the hydrocyanic acid; 3, to prevent organic changes in the nervous system, by depletion, general and local; 4, to remove all sources of irritation, as scybala in the bowels, &c.; and, 5, to avoid all sources of augmented spasm, such as shocks, noises, &c. The most successful remedies appear to have been the sulphate of quinine and the carbonate of iron, in large doses.

IV. *On Hydrophobia.*

1672. Another terrific disease of the nervous system, arising from causes acting at a distance from the nervous centres, is hydrophobia.

1673. A wound inflicted, a poison inserted, probably in the substance of the fine fibrillæ of excitor nerves, is the cause of this disease.

1674. After a variable interval, the peculiar symptoms of hydrophobia display themselves. All these symptoms obviously belong to the true spinal or excito-motory functions; they consist in a peculiar spasmodic and terrible *dysphagia* and *dyspnœa*. The parts immediately affected are those which preside over ingestion.

1675. The trifacial in the face and in the fauces, and the pneumogastric in the larynx, appear to be most unduly impressible. The impression upon these nerves is reflected

upon the muscles of the pharynx and larynx; and the sense of dysphagia or of dyspnœa is overwhelming. The slightest motion in the atmosphere, the application of a glass or cup to the lips, the sight or idea of water, or other fluids even, are attended by an agony of suffering—of mingled spasm, choking, strangulation, and terror.

1676. There are, from the first, extreme anxiety of the countenance and inquietude of manner, and a peculiar aggravation of these appearances at the sight of fluids, or on feeling a gust of air pass over the face, and still more on attempting to drink; by any of these causes, an expression of horror, a sense of suffocation, with constriction about the throat, and convulsive movements, are produced, which are terrible to witness, and impossible to describe. There are similar symptoms, independently of these causes, only in a minor degree. Later in the disease, the agony of expression and suffering is extreme; viscid saliva forms and collects in the mouth, and is removed with impatience and horror, and spasm about the throat; the mind begins to wander with a terrible delirium; the limbs are moved with continual spasm and agitation. At length, the powers of life and of the disease sink together, and perhaps suddenly.

1677. M. Gendrin, in a note to his translation of Dr. Abercrombie's work, ed. 2, p. 578, remarks,—" J'ai observé plusieurs hydrophobes, et j'ai assisté à l'ouverture des cadavres d'un plus grand nombre encore; il n'y a que quelques mois que j'ai suivi cette horrible maladie, depuis les premiers symptômes jusqu'à sa funeste terminaison; je n'ai jamais vu la moindre trace d'inflammation ou de lésion quelconque dans les organes encéphalo-rachidiens, ni dans les nerfs ganglionaires. La seule lésion que j'ai reconnue est un développement considérable, le plus souvent inflammatoire, des cryptes muqueuses de la base de la langue, du pharynx et de l'orifice supérieur du larynx. Les hydrophobes meurent asphyxiés: on trouve dans leurs cadavres, comme dans ceux des tétaniques, une congestion assez marquée dans les veines pulmonaires, un état général de congestion des principaux viscères, et particulièrement du cerveau, et le sang liquide d'un rouge obscur dans les vaisseaux*."

* Abercrombie, p. 578.

1678. The treatment of hydrophobia has hitherto been abortive; every remedy which the terrors of the disease, or the ingenuity of physicians, could suggest, has been tried in vain. Dr. A. T. Thomson's case was apparently mitigated by the hydrocyanic acid. Dr. Physick ingeniously suggested the propriety of tracheotomy. If a case were committed to my charge, I would combine these two modes of treatment. The strychnine might induce tetanus, or hydrophobia, but can never cure it, except upon a principle of similia similibus.

V. *Hysteria.*

1679. Vast, indeed, is the distance which separates hysteria from epilepsy; yet how *similar* are the symptoms of these two diseases. There is *one* great distinction—in hysteria, much as the larynx may be affected, it is never closed; in epilepsy it is closed: in the former, we have *heaving, sighing, inspiration*; in the latter, *violent, ineffectual efforts* at *expiration:* in the former, the cerebrum, the true spinal marrow, are comparatively unaffected; in the latter, they are in a state of congestion. See p. 95.

1680. Hysteria frequently depends upon the state of the stomach and bowels; still more frequently, as its designation implies, and like epilepsy, it arises from various conditions of the uterine system; and very frequently it is connected with the state of the mind and emotion—*cause* and *effect.*

1681. Some seem to imagine that hysteria is a *feigned* disease; this it is not; it is *real* enough, but it is generally *exaggerated.* This is, I believe, the true view of the matter; to this the peculiar condition of the mind seems to give origin.

1682. Hysteria seems to single out and affect every organ, every function which belongs to the true spinal system. Like the emotions, it also affects the action of the heart, the secretions, especially that of the kidney, &c. I will merely add, in this place, the following table of the parts obviously under the dominion of the true spinal marrow, which are affected in this multiform disease:—

1. *The larynx*—imitation of croup; apparently imminent suffocation.
2. *The pharynx*—dysphagia.

3. *The respiratory organs*—dyspnœa, cough, hiccough, retching, and vomiting, &c.
4. *The cervix vesicæ*—dysury, retention.
5. *The muscular system*—trismus, tetanus, contracted hand, distorted foot, twisted legs, &c.

1683. The rest relates to emotion, which is the magna pars of hysteria; as hysteria, in its turn, is, in the deluded and the deluding, the magna pars of Mesmerism, animal magnetism, or by whatever other ridiculous term so ridiculous a thing may be named.

VI. *Spasmodic Asthma.*

1684. I have already alluded to this subject: § 448.

1685. The similarity between the croup-like disease, or the laryngal asthma and this, or the bronchial asthma, is most marked. A morbid state of the stomach induces both; both come on in attacks, and in the first sleep; both cease, as by a charm, from change of air; both are instances of reflected irritation: the difference consists in the partial closure of the larynx in the former disease, and its open state in the latter, a difference which is probably the cause of all the other differences between these two diseases.

1686. The simplest form of asthma is that immediately induced by taking some indigestible substance; or, perhaps, still more immediately induced by the inhalation of certain kinds of dust diffused in the atmosphere, as that raised by shaking a feather-bed, the powder of ipecacuanha, &c. The incident branches of the pneumogastric, or internal excito-motory nerve, are excited; the action is reflected by the medulla oblongata upon the motor branches, and, as I believe, upon the circular muscular fibres of the bronchial tubes. These tubes are contracted, and the phenomena of asthma are induced. A constipated state of the large intestine acts in the same manner through the incident spinal nerves. Contracted bronchial tubes explain all the phenomena: the dyspnœa, the urgent, rapid, imperfect, bronchial inspiration; the protracted wheezing bronchial expiration; the bronchial rattles under the stethoscope, especially during expiration; the excited secretion of mucus; the cough; ultimately, the dilated air-cells, the dilated heart, &c.

1687. As certain additions to the atmosphere induce asthma, so certain others, as the smoke of tobacco, of stramonium, relieve the disease, and upon similar principles. As asthma is a morbidly excited state of the true spinal nerves, so remedies which subdue the action of that system, as the hydrocyanic acid, constitute our most prompt remedies in this disease. Swallowed, or inhaled, this remedy is invaluable, in this and in the cognate diseases, as the croup-like disease, pertussis, &c. &c.—the first exciting cause or causes being removed.

1688. How singular is it, that ipecacuanha, taken into the bronchia, should excite asthma, and, taken into the stomach, should induce another affection of the respiratory system, vomiting. How does every step in this inquiry lead to new comparisons, new illustrations of disease.

1689. We cannot mistake asthma: we must remember that its attack is generally sudden, frequently in the first sleep; trace it to its immediate cause; if this be an indigestible meal, give a mild emetic; if a morbid state of the intestines, the warm water enema and a brisk purgative; if a north-east wind, or a dry atmosphere, imitate the genial south-west by diffusing warmth and moisture throughout the patient's room. A fomentation to the chest often does great good; we must have recourse to the other remedies which I have mentioned; and then guard the patient against future attacks by teaching him to avoid its causes.

1690. Some patients can breathe in London who cannot in the country; some in the country who cannot in London; some can breathe in the lowest room who cannot in the higher stories. We must ascertain these peculiarities, and propose the plans which they suggest to us. I need not say how important it is to avoid the attacks of asthma; the mere momentary suffering of the attack is nothing compared with the emphysema of the lungs, the disease of the heart, which repeated attacks induce.

1691. I have noticed a case in which a shot passed into the trachea, and eventually into a bronchial tube, as a person was drinking out of a bottle, which had been cleaned, as is usual, with shot; it induced asthma. This asthma ceased at once on one occasion, when the patient expectorated the shot.

The rationale of this case is perfectly obvious to those by whom the actions of the true spinal system are understood.

1692. Lastly: in some cases of chronic bronchitis we observe phenomena similar to those of the asthmatic seizure.

1693. In confirmation of the views given on this subject, I propose to make a series of experiments to ascertain the power of muscular action on the bronchial tubes, by the immediate and reflected action of galvanism. A glass tube will be fixed in the trachea, and this will be placed in blood-warm water; galvanism will then be passed through the water, and through the excitor and motor nerves.

VII. *Tenesmus and Strangury.*

1694. I had recently a most interesting case of spasmodic stricture of the sphincter ani. The finger could scarcely be introduced. It was discovered that a calculus existed in the urethra; when this was removed the stricture immediately ceased.

1695. There is no fact so familiar as the retention of the urine produced by a ligature applied to hæmorrhoids; the cause and effect are removed together.

1696. Tenesmus almost always implies the existence of strangury, and strangury that of tenesmus. They induce each other; they are *similar excito-motory* phenomena, affecting the exits of two organs.

1697. Teething in children has produced both these actions, through a more remote arc of the true spinal system.

VIII. *Sexual Abuse or Excess.*

1698. This subject has been fully discussed by M. Lallemand, but in a manner not suited to *our* modes of thinking. Nevertheless, sexual abuse (*venus solitaria*) and excess (*venus nimia*), are the real source of much deplorable suffering.

1699. These causes affect the generative organs themselves, the urinary system, the true spinal system, the cerebral system, especially, but also the whole œconomy.

1700. Such susceptibility of the generative organs is some-

times induced as to lead to a seminal emission on the slightest excitement, physical or mental, and consequent impotence. In such cases, even the evacuation of the bladder, or of the rectum, frequently induces this effect!

1701. This state of things is further induced by, the simultaneous influence of hæmorrhoïds, scybala, ascarides, fret about the glans penis or cervix vesicæ, gravel, and morbid conditions of the urine, &c. This condition entails upon the miserable patient, loss of strength, of flesh, of digestive power, of mental energy, with despondency of the most deplorable kind, and the worst forms of debility, of emaciation (tabes dorsalis), of imbecility of mind; cachexia, phthisis, &c.

1702. Excess and abuse induce every kind of derangement of the bladder and kidneys, involving derangement of the stomach, and general debility and emaciation.

1703. But the influence of this cause on the true spinal system is more extensive still. I have already adverted to this subject, § 1167, 1168: a peculiar susceptibility of the *excitor* nerves of the general surface, but especially of that of the penis, or of the *centre* of the system itself, is induced, with affections of the rectum and of the bladder, and especially their sphincters, impotence, a peculiar sort of *spasmodic paralysis* of the legs, and even of the hands and arms.

1704. Of the kind of *mania* to which I have alluded, I can only further observe that a solitary vice is not only a frequent cause of it in both sexes, but the frequent cause of the insufficiency of all our modes of treatment. The secret must be discovered; and then the most absolute and vigilant restraint is the only remedy.

1705. The remedies for this most deplorable state of things, are protracted abstinence or temperance; in addition to these, a system of very active exercises and recreations, regulated thoughts, well-chosen studies, early hours, the salt-water shower bath,—tepid at first, afterwards cold; the mildest nutritious diet, without stimulus. To these, local cold bathings, cantharides, &c. may be added.

1706. The important questions are, that of the *diagnosis*, the detection of the cause, and its removal.

IX. *Abortion.*

1707. I have a number of facts which prove that abortion is frequently an excited act, excited through the spinal nerves of the rectum, and that its prevention depends upon removing and avoiding the causes of this excitement, especially by emollient and opiate enemata.

1708. A frequent cause is a morbid and exciting state of the contents of the rectum. The death of the fœtus is another cause; as a foreign body, it excites the contraction of the uterus.

1709. Abortion frequently occurs in the early months after marriage, from excesses. Once occasioned, it is apt to recur from the operation of similar causes less in excess, and on some obscure principle of habit; and, therefore, especially at the *same* period of pregnancy. Every impression on the excitor nerves should be carefully avoided, especially when that period arrives.

1710. The difference between the excited acts of the rectum and bladder, and of the uterus, is--that in the latter the expulsors, the sphincter or the cervix in the former, are the active organs excited to contraction: in the former, the excernenda are frequently retained; in the latter, they are expelled.

1711. The whole question of abortion and parturition, and in a word of *Obstetrics*, as a science, is one of the true spinal system; and he will do humanity great service who, with suitable opportunities, will trace it fully.

X. *Incontinence of Urine.*

1712. This distressing and humiliating affection of young persons frequently depends on a loaded state of the large and last intestine, and on an acrid condition of the urine.

1713. Both these conditions should be corrected by mild aperients, made effective by morning enemata of warm barley-water, and by the bicarbonate of potash and diluents.

1714. The dinner should be *early*, and no supper should be taken; so that digestion and its well-known effect on the urine may be over.

1715. Tea should also be taken at an *early* hour, and in very limited quantity.

1716. In addition to these plans, the patient should be made to empty the bladder sometime after being in bed.

1717. As immediate remedies, the uva ursi and cantharides may be mentioned; the former being more suitable to the case of irritability, the latter to that of debility, if these conditions can be accurately determined.

III. *The Centrifugal Diseases.*

1718. They are diseases of the reflex motor nerves.

1719. Spasmodic affections may arise from causes affecting the *excitor* nerves, the *spinal axis*, or the *motor* nerves of the true spinal or excito-motory system; the first and second have been noticed already. It now remains for me to treat of the third. The first of these is—

I. *Spasmodic Strabismus.*

1720. I have already noticed the strabismus which arises from *paralysis* of cerebral and voluntary nerves, and some of the muscles of the eye-ball. I now wish to draw my reader's attention to another form of strabismus, not hitherto distinguished from the former, and which I believe to be an affection of the roots of the motor nerves of the true spinal system.

1721. In the former case, the patient can frequently move the eye-ball fully, in every direction except one; at a certain point, the eye-ball stops, although the other eye continues to pursue an object placed and moved before it. This is the case with a patient at this moment under my care for attacks of sickness, with defective vision and motions of the eye.

1722. In spasmodic strabismus the motions of the eye may be perfect, except on certain occasions of excitement, or of disorder, or of intense application, or of employment of the eye; the strabismus then becomes apparent; the eye-ball is obviously *drawn* in one particular direction.

1723. In one interesting little girl, aged about three years, the strabismus came on whenever a stranger came into the room, whenever she was asked to read, &c.

II. *Spasmodic Tic.*

1724. The next of these nerves is the *seventh*, or *facial*. So long ago as the year 1817, I published, in the "Edinburgh

Medical and Surgical Journal," an interesting case, which is plainly one of spasmodic affection through this nerve :—

1725. Miss Inman, aged nineteen. *Two years ago,* in the winter season, the face became affected, during the course of one night, in the following manner: all the muscles of the right side of the face were drawn into a state of spasmodic contraction; the sensibility of the skin became much impaired, the contact of an external object inducing a feeling of numbness; there were a degree of swelling, and considerable pain; and a sense of rigidity was felt in the muscles of the right side of the neck.

1726. The muscular contraction was permanent, and very considerable; the right angle of the mouth was drawn downwards; the retraction of the integuments usually observed extending from each nostril obliquely downwards, is, on the right side, very deeply marked; on the left it is seen in the natural state. The point of the nose is drawn considerably towards the right side. The right eye-brow is drawn a little lower down than the left one; and two small dimples, the effect and evidence of muscular contraction, are seen immediately above it. A dimple in the chin is also distinctly marked, and is drawn considerably to the right of the mesial plane of the face. Articulation was, at first, very indistinct, and is still so in some degree; the letter *S,* especially, is pronounced with difficulty, and participates in the soft sound of *th.* There is no difficulty in deglutition; but considerable inconvenience occurs during mastication, from a tendency of the bolus of food to pass and collect in the right side of the mouth. On closing the right eye, a degree of tightness is induced and felt at the right angle of the mouth; this tightness is *seen,* even when the patient speaks with the right eye perfectly closed. On drawing down the right angle of the mouth, by an effort of the muscles of this part of the face, the upper eyelid of the right eye is also drawn sensibly downwards, and the eye is partially closed. In the first instance the eye was closed with difficulty. This fact, with the date, prove that it was originally *paralysis.* It is now *spasm.*

1727. The state of contraction of the muscles is seen much more distinctly, and the deformity induced is much

greater on speaking or laughing, than when the patient is in a state of tranquillity.

1728. At present, the contraction of the muscles is much less than at first; the sensibility is perfectly restored. The diminution of the symptoms took place during the administration of electricity, the operation of blisters, and the exhibition of an emetic, followed by purgative medicines.

1729. This affection was considered by the patient as an effect of cold. The swelling and pain were deemed an attack of toothach, but without reason, as there is no decay of any of the teeth. Before and about the period of attack, pains were experienced in both arms and wrists, and were considered rheumatic. During two years, previously to the accession of the affection described, this young lady had experienced some general indisposition, having been feeble, nervous, and subject to difficulty of breathing and palpitation of the heart. The catamenia had been somewhat irregular. The ankles were affected with œdematous swelling in the evening of each day.

1730. This case is deemed particularly interesting, as it establishes a distinct diagnosis between a *spasmodic affection*, and a case very similar in appearance, consisting of *paralysis* of one side of the face; a distinction which, it is thought, has been sometimes neglected. A further diagnosis, to which the practitioner must attend, consists in the distinction between a primary paralysis of the muscles of one side of the face, occasioned by the agency of internal causes, and a secondary paralytic affection, the consequence of pressure external to the brain. See *Plate* VII, *fig.* 1, 2, 3, 4.

1731. In the "Annuaire Medico-Chirurgical des Hôpitaux," published in 1819, there is (p. 406) an interesting case of a wounded facial nerve:—

1732. "On the 27th of February, 1814, Charles Leroux was wounded at the battle of Bar-sur-Aube. The ball struck him, from the distance of fifteen paces, on the left side of the face.

1733. "He felt but slight pain at the instant he received the wound. The only consequences which followed were a trifling swelling of the cheek, with a slight alteration in vision, shooting pains in the eyes, and a peculiar sensibility

accompanying the act of mastication. Twelve days after the accident, the wounds were completely cicatrised.

1734. " The most extraordinary circumstance of this case is, that when this man attempts to speak, laugh, or eat—in fact, whenever it is necessary to move the jaws—the sub-labial muscles contract involuntarily, and as if by sympathy. While the jaws are at rest, these muscles appear to be in their natural state, and the face offers no traces of change; but no sooner are the jaws moved, though very slightly, than the act is accompanied with the most frightful grimace, of which the patient is unconscious. The countenance changes and becomes hideous, and it is hardly possible to recognise it. This alteration of the features is much greater on the left than the right side of the face. This phenomenon, may, I think, be explained by the lesion of the sub-orbitar nerve. With regard to the sensibility accompanying the mastication, which, a month after the accident, was still felt, it must be attributed to the passing of the ball through the sub-maxillary alveoli, and to the shock resulting from it."

1735. For my own part, I do not pretend to have understood the case, which I have given § 1725, and which I observed and detailed merely as one of clinical observation and diagnosis. M. Beauchène, the author of the second case, is absolutely in error in considering it as an affection of the sub-orbitar nerve.

1736. In the spasmodic tic, the countenance is *drawn* to the affected side; and it is the eye of the *same* side which cannot be closed. It is distinguished by this circumstance, from *paralysis* of the facial nerve. In *Plate* VII, *fig.* 3, *and* 2, 4, *spasmodic* affection of that nerve on the right side is contracted with its paralysis on the left. It is a peculiar affection not discriminated from the former, and will be illustrated by the following case :—

1737. George Jefferson, aged forty, formerly a lamp-lighter, now a seller of fruit in the streets, was affected three years ago with general rheumatism, in the midst of which this singular affection of the muscles of the face came on.

1738. The two sides of the face are not alike; the left is nearly natural, but the right is affected with spasmodic contraction; the chin is drawn to one side, and dimpled; the

right angle of the mouth is drawn downwards; the right eyebrow is higher than the left. Sometimes there is a little rapid spasmodic action of the muscles. *Plate* VII, *fig.* 3.

1739. When he is told to shut the eyes promptly and forcibly, the distortion is tenfold; the right eye is drawn and only partially closed; the right angle of the mouth is drawn spasmodically downwards; the nose and the chin are drawn to the right side.

1740. He laughs and bites perfectly on the left side. On attempting to open the mouth wide, it is obviously *tied* by the muscles of the right side. He cannot whistle; in the attempt to do so the mouth is drawn to the right side.

1741. He takes snuff through both nostrils indifferently; on sneezing, the left side of the face is chiefly distorted.

1742. The right side is a little benumbed in feeling; it is also colder, after exposure to cold, than the left.

1743. Besides these two cases, I have seen several others; in one there was a defect of vision, with the spasmodic tic; in another, the tic was confined to the outer portion of the orbicularis. The former was of the most extreme character; the face being exceedingly distorted on each spasmodic attack. The latter was comparatively slight. The former probably arises from disease of the facial nerve *within* the cranium,—the latter appears confined to that branch of the facial, *exterior* to the cranium, which supplies the orbicularis.

1744. The *causes* of this affection are the usual causes of inflammation; the most frequent is exposure to a keen wind, either extremely cold, or with rain, or sleet,—a *coup de vent*, as it is termed.

1745. The remedies for this disease are unknown; in the severer cases just mentioned, aperients and mercury have been fully tried in vain. I have proposed local depletion and counter-irritation, by means of the cupping instruments.

1746. Recently I have seen great benefit accrue from the use of fomentations, and of a sharp liniment.

1747. Before I leave this subject, I must say a few words upon *distortions* of the face in general. These arise from paralysis, and this may have its seat in the cerebrum, or in the facial nerve; or from spasm. In *hemiplegia*, the eye-lids of the right or paralytic side are closed by an act of volition,

although not so perfectly as those of the unaffected side; the *sensibility* is generally diminished; the tongue is protruded *towards* the paralytic side, by means of the contraction of the unaffected side of the genio-hyoid muscle, *fig.* 1. In paralysis of the *facial* nerve, *fig.* 2, 4, the eye-lids cannot close at all; the sensibility of the face and the movement of the tongue are natural. The case of spasm is described, § 1738, 1739, and depicted *fig.* 3.

1748. I must here adduce a recent and most interesting case of this last affection :—

1749. Lady S********, after exposure to severe cold, became affected with *paralysis* of the *right* side of the face: the *right* eye-lids could not be closed, the features were drawn *to* the *left* side, the food gathered into the *right* side of the mouth during mastication, and the saliva flowed from the *right* angle of the mouth; in process of time, all this changed; the *right* eye-lids not only closed on an act of volition, but closed spasmodically; the face was drawn *to* the *right*, especially on laughing, and during mastication on the *right* side, and a dimple formed on the *right* side of the mesial line of the chin.

1750. It was supposed that the disease had affected the two sides of the face in succession,—that it was, at the first, paralysis of the right facial nerve, and then of the left. But the state of the eye-lids sufficiently denoted that the change was not from one side to the other, but from paralysis to spasm of the *same* side: it was always the eye-lids of the right eye which were affected, those of the left being always in their normal condition; at first, these lids could not be closed, afterwards the attempt to close them induced spasmodic action.

1751. From the misapprehension in relation to this case to which I have alluded, the remedies were actually prescribed to be applied to the unaffected side of the face!

1752. This case affords a most interesting exemplification of the important fact noticed, §§ 1385, 1392, and especially § 1389.

1753. Even the ordinary impression of *cold* induces, *first*, numbness and paralysis of the fingers, and *then* the pains familiarly termed "hot-ache." In one case, exposure to severe cold induced numbness of the face, which gradually passed into a terrible *tic douloureux*. Similar effects are also

induced by *pressure;* at first there is numbness, then the painful sensation called "pins and needles."

III. *Spasmodic Torticollis.*

1754. This spasmodic affection of the sterno-cleido-mastoid muscle has long been known to physicians. It is obviously of the same character as the spasmodic strabismus, and spasmodic tic—an affection of the *true spinal motor* nerves.

1755. The following interesting case was communicated to Sir Charles Bell by Dr. Knight:—

1756. "Sir,—About December, 1827, Master —— was seized during the night with a stiff neck; it excited little attention; he played with his schoolfellows as usual, some of whom playfully, but rather rudely, twisted his head in contrary directions. When he returned home at the Christmas holidays, I was requested to see him. I found his general health very much deranged, and his sterno-cleido-mastoideus muscle on the right side rigidly contracted; leeches and fomentations were applied to the mastoid extremity of the muscle; alterative medicines were prescribed; strict attention was paid to the bowels; and, after some weeks, his general health very much improved: still the muscle remained as rigid as ever. During the summer, his father took him to London, and you were consulted. I believe he was advised to go to the sea, and a steel apparatus was recommended. The sea, I understood, was of service to him; but, as the apparatus did not improve, and injured his back, it was, after some weeks' trial, laid aside. A vigorous system of shampooing was then adopted, together with very active exercises. His health improved; he grew taller and stouter; and, by great effort, he could stand straight; but, the moment he relaxed his efforts, his chin turned towards his shoulder, his spine became curved, and he relieved himself by resting on one leg.

1757. "All remedial measures were at length abandoned, and this last half-year he was sent to school. His general health has continued good, but his sterno-cleido-mastoideus is just as it was."

1758. Sometimes the head is drawn to the shoulder;

sometimes it is moved to and from one side, with a rocking motion.

1759. The persevering use of fomentations, liniments, sinapisms, and frictions, and division of the muscle, are the remedies in this affection.

IV. *Spasmodic Respiration.*

1760. The following sketch is taken from Sir Charles Bell:

1761. "The condition of this woman is very peculiar: in her, common breathing inspiration is performed with a sudden spasmodic action; but she is also affected at intervals with more violent spasms, and her respiration is then hurried and distressing. On the commencement of a paroxysm, she bends her body slightly forwards, and thus prepares herself, as it were, for the attack; her nostrils are dilated widely, the angles of her mouth are dragged forcibly downwards, there is a constriction of the throat, and the shoulder and chest rise convulsively, as when a person has cold water poured upon the head; the inspirations are deep and violent, and are attended with a sniffing of the nostrils, the air being inhaled through them only, and not through the mouth. The fibres of the platysm amyoides start into view, and there is quick rising and falling of the pomum Adami; the sterno-cleido-mastoideus and trapezius, on both sides, act powerfully, fixing the head and elevating the shoulders.

1762. "The spasmodic action of these muscles exists, to a considerable degree, constantly; yet it increases in paroxysms which last so severely for a few minutes that she is deprived of the power of speech, and seems to be almost suffocated. These paroxysms recur at irregular intervals. It was observed by the attendants, that when she was excited by walking about the ward, or by replying to our questions, they returned more frequently.

1763. "She could move her head with perfect freedom when we requested her; but still the spasmodic action continued. She also raised either shoulder, or twisted her face to one side, when she was desired. This woman continued under the care of the physician for about a month, and was discharged cured*."

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* The Nervous System, p. 140.

1764. I have recently attended a patient, a young gentleman aged about twenty, who experiences attacks of a peculiar affection of the movements of *respiration;* he lost the power of articulation: on attempting to speak, he was suddenly seized with a spasmodic action of the diaphragm, which induced a sudden *inspiration*, with a hissing noise as the air entered through the lips, and pain in the points of attachment in the diaphragm. This affection yielded to attention to diet, and to the state of the bowels.

1765. The *source* of these affections of the respiration is probably deeper than the motor nerves.

1766. These and other affections of the true spinal *motor* nerves agree in several particulars: 1, they are usually suspended during sleep (in this they differ from *similar* affections *excited* through the true spinal *excitor* nerves, which frequently come on during sleep); 2, they are redoubled by any cause of mental hurry or excitement.

1767. I need scarcely remark that spasmodic strabismus has recently been remedied by division of the muscle affected. The same event has been accomplished in spasmodic torticollis. Doubtless the spasmodic tic might also be relieved by a similar operation performed by means of a proper instrument, which should merely *puncture* the cutaneous tissues.

1768. Is contraction of the hand and arms, of the leg and foot, ever an affection of the *motor nerves* merely? Or has it always an origin more deeply seated in the centre of this system? I suspect that in *infants*, or *young children*, this affection has sometimes arisen from exposure to cold—a "coup de vent." Infants are frequently very improperly exposed to the north-east wind, when very insufficiently clothed.

CHAPTER VIII.

DISEASES OF THE NERVOUS SYSTEM OF REMOTE ORIGIN.

1769. There is not in the whole practice of medicine a question more important than the one of which I am about to give a sketch. The affections of the nervous system of remote origin may be thus enumerated:

I. *Intestinal irritation.*
II. *Exhaustion from loss of blood.*
III. *Chlorosis.*
IV. *Arthritis.*
V. *Excessive study, shock, alcohol, &c.*
  1. *Delirium tremens.*
  2. *Delirium traumaticum.*
VI. *Affections of the kidney.*
  1. *Dropsy.*
  2. *Diabetes.*
  3. *Other morbid affections of the Urine.*
  4. *Ischuria.*

1770. Several of these affections are not seen in hospitals; it is in private practice only that we become acquainted with them. They are, also, almost neglected by writers on diseases of the brain; yet it is impossible that we should be prepared for practice without a due knowledge of these diseases.

I. *Intestinal Irritation.*

1771. The first of these affections consists of the irritation of indigestible food, scybala, or other morbid contents of the stomach, or bowels, excited into activity by some *shock* of the system, or of the nervous system, such as a fall or other accident, parturition, &c.

1772. The symptoms are, rigor, frequently severe heat of surface, and violent pain of the head, with intolerance of light and of sound; the symptoms, in a word, of the most acute encephalitis.

1773. The breath is tainted, the tongue loaded and swollen, the secretions morbid; but it would still be difficult to establish a distinct and confident diagnosis without the criterion afforded by the effect of bloodletting in the erect posture, of which I shall speak presently.

1774. The first step to be taken in a doubtful case, is very slowly to administer an enema of from three to three and a half pints of warm water, and to examine the state of the fæces, and observe the effect upon the disease and upon the system. If there be scybala, if the symptoms be subdued, and especially if there be faintishness, the case is indubitably not cerebral inflammation, but intestinal irritation.

1775. If the case still remain doubtful, we must prepare the arm, open a vein, and then place the patient upright, and let the blood flow until the lips become pallid; if the case be encephalitis, an extreme quantity of blood will flow, even thirty or forty ounces, or more, before there is any appearance of syncope; if it be intestinal irritation, syncope occurs before one-fourth of that quantity of blood has left the circulating system!

1776. I have insisted so much upon the importance of a knowledge of this disease, and upon the nature of this diagnostic, and guard against undue and inefficient bloodletting, in several works, that I shall now merely refer to them for further information, which it would occupy me too long to repeat on this occasion. See p. 293, *note*.

1777. This affection sometimes assumes a far less acute form. I met with such a case very recently; it had been mistaken for encephalitis. The patient slowly but perfectly recovered from attacks of vertigo, &c. by maintaining a regular state of the bowels, diet, rest, and afterwards of gentle exercise, change of air, &c.

II. *Exhaustion from Loss of Blood.*

1778. I must refer my readers to the same works for information on this important subject.

1779. Throbbing, pain of some part of the head, a sense of pressure, as of an iron nail, or of an iron hoop; intolerance of sound, of disturbance; sleeplessness; a state bordering on delirium; actual delirium, or even mania; some convulsive

affection, perhaps epilepsy itself, are the affections which most frequently result from loss of blood.

1780. In other cases there are amaurosis, deafness, paralysis, a state of dozing, or slight coma,—the "apoplexia ab inanitione."

1781. There are some observations upon this subject in a recent volume of the Medico-Chir. Trans. (vol. xiv, p. 381), by Sir B. Brodie: some time after an injury of the head, it became doubtful whether the symptoms depended upon the original accident, or upon the treatment. The plan was changed, and the patient recovered. In the "Medical Gazette" there is an interesting case of *amaurosis* from loss of blood, by Professor Badham, of Glasgow, occurring in his own daughter. I believe there was much obscurity in the case until the Professor was shown my work upon the effects of loss of blood.

1782. I have known such cases treated upon antiphlogistic principles until there was the most imminent danger, when a change of plan has immediately induced a favourable change, and eventually restored the patient.

1783. Gentle stimulants, such as small quantities of brandy, and the carbonate of ammonia; chalybeates, and a mild animal diet, are the principal remedies in such cases.

1784. I will conclude these brief remarks by observing that the first series of symptoms are entirely cerebral; those observed late in the disease conjoin with cerebral symptoms, symptoms which belong to the true spinal system; the half-closed eye-lid, a degree of stertor, an uncertain state of the sphincter, convulsion, are of this character. Eventually, in the very last stage, the ganglionic system suffers; mucus accumulates in the bronchia, and serum in the air-cells and cellular substance of the lungs; and flatus distends the intestines.

1785. After death, effusion is found to have taken place under the arachnoid, at the surface and base of the brain, and into the ventricles; there is œdema of the lungs, the intestine, &c.

1786. In connection with this subject, I must mention that I frequently see patients who are affected at once with *extreme pallor* (perhaps without having suffered from loss of blood), with pain of the head, vertigo, and other symptoms of

this kind. The treatment consists, not in depletion (this is quite a mistake), but in gradually restoring the due *equilibrium* of the system, by stomachics, aperients, the mildest chalybeates, exercises, the open air, nutritious diet, early hours, &c.

1787. I need scarcely advert to the strict affinity between intestinal irritation and loss of blood, and *puerperal mania*. On this subject, I must again refer to works formerly quoted. See p. 293, *note*.

III. *On Chlorosis.*

1788. The influence of the state of bloodlessness, which occurs in chlorosis, upon the encephalon, has not been duly noticed by practical writers; I shall, therefore, mention this subject a little more in detail than some others.

1789. I have, within the last eight years, seen four cases of fatal chlorosis. The fatal event took place in one case suddenly; the patient was seized, quite unexpectedly, with the symptoms of dissolution, whilst sitting up for a few minutes in a chair when in a state of apparent convalescence from a feverish cold, and speedily expired. In the second case, a feverish cold led to the symptoms of a more gradual sinking. In the third, fever, cough, and aphthæ, followed parturition, and issued in the sinking state. The fourth and last case issued, in the most insidious manner, in a series of symptoms of an equally insidious sinking of the vital powers.

1790. Of the second and third cases, no post-mortem examination could be obtained. In reference to the first and last, and especially the last, I was more successful in my entreaties to obtain this satisfactory elucidation of the nature of the disease.

1791. Miss H***, aged eighteen, was well, with the exception of a little constipation, when she went to school at Boulogne, in 1828, aged thirteen.

1792. She remained a year, and returned home. She went again in six weeks, and remained another year; and, during this year, the catamenia did not appear, and the bowels were constipated. On her return, she looked pale, but she was stout, and grown, lively, and in good spirits.

1793. A fortnight after her return, the catamenia appeared, but they were pale and scanty; the bowels were constipated.

1794. She continued pretty well until July, 1833, when she became sallow, pale, affected with pain of the head, and shortness of breath, and coldness and dampness about her person; the catamenia gradually diminished in quantity and colour; the bowels were constipated, and she became fond of concealing and eating dry rice, coffee, and tea-leaves.

1795. About a year ago the paleness was augmented, and the ankles began to swell; leeches were applied to the temples!

1796. During the last summer, the paleness augmented still further, and the œdema assumed the character of anasarca; the perspiration became offensive; the catamenia were scanty, pale, and yellowish, or greenish, and varying much in colour, but never red.

1797. I first saw Miss H*** on December the 6th, 1834: the countenance was pale, and slightly œdematous; the legs anasarcous; the head affected with mild delirium, with a degree of intolerance of light and noise; the breathing was hurried, and rather audible and rattling, with cough; the pulse 130, and throbbing; the abdomen tumid.

1798. These symptoms continued: at first there was delirium, afterwards there were dozing and slight coma; afterwards the mind was clear; at length the coma returned; the respiration became momentarily suspended, and the inspiration sudden, and sometimes *catching;* the abdomen became decidedly tympanitic, with the escape of much flatus; the pulse continued at 130, and sometimes 140, with fulness and throbbing. Here are abundant proofs of the connection of this chlorotic condition with the nervous system; its relation to mania has been already noticed.

1799. The strength gradually declined, and dissolution took place rather suddenly, after the free evacuation of the bowels.

1800. On examination, there was effusion of serum and of opaque lymph under the arachnoid, at the summit and base of the brain; there was an effusion of six drachms of serum into each ventricle.

1801. The summit of each lung was extremely pale, œdematous, but crepitant between the fingers; large portions of foaming lymph exuding from incisions made into them; the

root of each lung was red, not crepitant, and sank in water; and, on making incisions, much fluid exuded without *foam*, or bubbles of air. The bronchia were injected; each cavity of the thorax contained five or six ounces of serum, and the pericardium one ounce; the heart was natural.

1802. The viscera of the abdomen, except the ovaria, were natural, but pale; there was no effusion; the tympanitis had disappeared. The ovaria were large, and one of them contained a cyst replete with serum, of the size of a large walnut.

1803. There was considerable adipose substance.

1804. This case is important in every point of view. It is important in regard to the nature of the disease of which it is an example, demonstrating, as it does, the tendency of that disease to induce, not merely external dropsy, but effusion under the arachnoid, and into the pleura, the pulmonary cellular membrane, &c. It is important, too, as an unequivocal representation of the disposition to such organic changes in cases of bloodlessness and exhaustion. It is also important, as establishing the fact, that not only serous effusion, but the deposit of coagulable lymph, may take place, without inflammatory action, in similar circumstances, and that, consequently, such deposit of lymph is no proof of inflammation.

1805. In a recent fatal case of delirium tremens, serum was found effused under the arachnoid, and into the ventricles, whilst opaque lymph was deposited under that membrane. Similar appearances observed in chlorosis, enable us to say that such an appearance cannot be adduced in proof of inflammatory action; for no one can imagine that the appearances which have been detailed, as observed in chlorosis, can be any other than the peculiar effects of this disease, or that the deposit of lymph under the arachnoid can depend upon any cause different from that which induced the effusion of serum under this membrane, and from the pleura, and the pulmonary and cutaneous cellular membranes.

1806. I need scarcely add the remark, that chlorosis must not be viewed as totally free from danger. When anasarca has supervened to great pallor, there is the fear of effusion into the encephalon, and of a fatal result, which is sometimes of the most insidious, sometimes of the most sudden kind.

IV. *Of Arthritis; Pallor; &c.*

1807. The connection between arthritis and the nervous system has not been so fully investigated as it needs to be.

1808. I shall merely adduce one interesting case in illustration of this extensive pathological fact:—

1809. The Earl of C****** had suffered from arthritis, dyspepsia, and an attack of herpes phlyctenodes.

1810. He had then a fit, in which he became pale, staggering, and unconscious.

1811. He had another attack in St. James's Square, and fell down. He was taken home; soon recovered. There was no hemiplegia or other paralysis. But I observed, what I have observed after violent vomiting, coughing, and the parturient efforts, viz. minute ecchymoses on the forehead, and the loose cellular texture about one eye. I imagine that the attack was *epileptic*, and that it depended on the condition of the general health; the state of the bowels and of the urine being most morbid.

1812. This and other cases have induced me to watch arthritis as not free from the danger of attacks of disease of the nervous system. I can only hint at the subject here.

1813. I should mention that the Earl of C****** was affected with the *pallor* which I have noticed, § 1786, and which I regard as not unattended with danger. Inanition and repletion both dispose to effusion within the head.

1814. The immediate result of shock on the general system, but especially on the cerebral system, is of the most interesting character.

V. *Of Shock, Mental and Physical.*

1815. The effect of *mental* shock is frequently a state bordering on delirium, or mania. Suicide is a frequent event at such a moment. There are a sense of weight, or pain, about the head, and sleeplessness. There is great danger of mistaking the symptoms for mere mental affliction; we ought to *treat* it as a serious malady. The timely use of the lancet would have prevented many an act of suicide. But I will illustrate this point by a most interesting case:—

1816. A. B——, aged forty, became ruined in character

and fortune, and, when in the midst of his difficulties, experienced a sense of heaviness and pressure in the head, and passed sleepless nights. After several days, he attempted suicide, by dividing the muscles and blood vessels of the arm deeply. He lost a large quantity of blood, and became faint. On recovering from this state, he said to his medical friend,—"Had you bled me a few days ago, I should not have done this act; my feelings are altered, and I regard suicide with abhorrence; had Sir Samuel Romilly been timely bled, he had still been alive." From this time all the symptoms subsided.

1817. I twice visited, at the distance of ten miles from town, Miss ——. She was of a chlorotic pallor. She had experienced a *heart*-rending disappointment. She was in bed, affected with a rather frequent pulse, slight delirium, alternating with equally slight coma or dozing, a mucous rattle in the respiration, a tympanitic state of the abdomen, with the discharge of offensive fæces. In spite of every remedy, she gradually sank and expired.

1818. In the same village, I visited a gentleman who had recently lost a favourite brother. He gradually drooped, became sleepless and feverish, betook himself to bed, became delirious, then comatose, with mucous rattle in the respiration, a tympanitic state of the intestines, and discharges of blood, of morbid and offensive fæces, and flatus; the bladder became distended, and the catheter was required. He, too, in spite of every remedy—the mildest mercurials, the strictest attention to all the secretions and functions, with asses' milk, &c.—gradually sank.

1819. Both these cases appear to me to have been the effect of mental shock. At least, no other *causes* of those effects could be discovered.

1820. To the same *Class* of affections, doubtless, belongs the nervous delirium, or *delirium traumaticum*, described by Dupuytren, as following serious accidents and operations.

1821. There are sleeplessness, delirium, jactitation; the eyes are injected, the countenance flushed and animated; the forehead covered with profuse perspiration; the patient is insensible to the pain of his accident, or operation; there is no fever or constipation.

1822. This affection is frequent after attempts at suicide.

1823. The patient may fall asleep, awake composed and rational, relapse, &c. It is a short mania for five or six days; it is attended by great danger.

1824. There are no distinct traces of morbid change on examination. The brain and spinal marrow are found apparently healthy.

1825. The remedy recommended by Dupuytren is a small enema, with five or six drops of tinctura opii, repeated three or four times, at intervals of six hours.

1826. The shock of an operation, not in itself extremely formidable, has proved fatal.

1827. But what is more remarkable is, that this event has frequently been foretold in the most positive terms by the patient.

1828. The late Mr. B******** was advised to undergo amputation of the leg. Previously to this, he went and actually bespoke the place of his last tenement. He died shortly after the operation.

1829. Mrs. S******** had a tumor in the mamma. She underwent the operation for its removal, protesting that she should not survive. She, too, died after it.

1830. These facts cannot be uninteresting to the physiologist and pathologist.

1831. I have already repeatedly noticed the subject of shock. I have recently made and repeated some interesting experiments on this subject:

1832. In the presence of a young Parisian student, I divided the spinal marrow in a frog. I pinched the toes, but there was no movement, no reflex action. My companion observed—"Ah, c'est fini;" I replied, "Non, ce n'est pas commencé." In a few minutes, the reflex actions became obvious, and in a few minutes more most energetic. We had examined the circulation previous to the division of the spinal marrow. It was most active. But immediately after that division, scarcely a movement was to be seen. Like the reflex actions, however, the vigour of the circulation was gradually restored.

1833. In one frog, after the return of the circulation, I crushed the leg and thigh with a hammer. There was no

sensation of course, the influence of the cerebrum having been removed. The circulation again immediately ceased, as the effect of the *shock*. It again returned after a time.

1834. Another frog was left in the water all night. Not rising to the surface to respire, the circulation and the reflex actions were again extremely languid. I exposed it freely to the air, keeping it carefully moist. In half an hour, these two functions were again restored to their state of activity and vigour.

1835. I should think that Dr. J. Reid's experiments on the irritability of the muscular fibre were of this kind. I propose to examine the question on the first opportunity.

1836. But an important question is—in the case of shock from a fracture or contusion of the leg, for example, in the human subject (as in the case of Mr. Huskisson), should we *wait* for the rallying of the powers of life, or proceed to immediate amputation? Now this vital question might be illustrated by a series of experiments, even on the frog. Let the spinal marrow be first divided, to obviate suffering; let the limb be then violently crushed; then delay the amputation in one case, and perform it in another, and determine, by a sufficient number of trials, which plan is least injurious to life, by observing its subsequent duration.

VI. *The Effects of Alcohol.*

1837. These cases are obviously allied to *delirium tremens*, the result of drinking spirituous liquors. In this last case there are wakefulness, delirium, and tremor, singularly combined.

1838. The symptoms of delirium tremens may occur during the habit of taking alcoholic liquors, or immediately after the wonted stimulus is withdrawn.

1839. The first symptom is tremor; this leads to sleeplessness, and this to delirium; the delirium frequently consists in the imagined presence of objects, which the patient is anxious to seize or to avoid. The tongue is white; the breath tainted; the surface moist; the pulse becomes frequent.

1840. In the advanced stage, the delirium may be replaced by coma, the tremor pass into subsultus tendinum, the evacuations become involuntary.

1841. The attack of delirium tremens is very apt to recur. The first attack is rarely fatal, but a subsequent attack may terminate unfavourably.

1842. The morbid appearances observed, usually after the second attack, are the effusion of serum into the ventricles, and of serum, and even of lymph, under the arachnoid. See § 1805.

1843. I have known free blood-letting induce a degree of sinking, both in young and old, from which no means could restore the patient. Opium, with a strict attention to the diet, and to the secretions, constitutes the most efficacious remedy. The strait-waistcoat is a most important remedy. It becomes a serious question whether any stimuli should be allowed.

1844. There is an interesting fact in the "Précis d'Anatomie Pathologique" of M. Andral, t. ii, p. 770, illustrative of this latter question. A drunkard is cast into prison and put upon prison diet; becomes affected with delirium; he is allowed a certain portion of spirit and water, and immediately recovers:

1845. "Un homme très-adonné à l'ivrognerie fut jeté en prison pour cause de vol, et réduit tout-à-coup au régime du pain et de l'eau. Dès les premières semaines de ce nouveau genre de vie, on observe du trouble dans les facultés intellectuelles du prisonnier; son embonpoint et ses forces déclinent, sa figure pâlit et exprime l'abattement: il passe les nuits dans l'insomnie; plus tard, il survient un délire, qui, d'abord tranquille, devient ensuite de plus en plus furieux; il croit voir des figures horribles qui le jettent dans des angoisses continuelles: il pousse des cris perçans. Le docteur Hausbrandt, appelé à examiner le malade, apprend quelles étaient ses habitudes avant son entrée en prison, et soupçonne que l'entière abstinence des liqueurs alcoöliques est la cause de son dépérissement et de sa manie. En conséquence, il prescrit l'administration deux fois par jour d'une petite quantité d'eau-de-vie: les accidens cérébraux ne tardent pas à se dissiper, l'embonpoint et les forces reviennent ensuite peu-à-peu, le malade recouvre enfin sa première santé, et la conserve pendant tout le temps de sa détention*."

* Journal de Progrès, &c. t. i, p. 268.

1846. The three affections which I have thus briefly noticed, highly merit our best attention.

1847. I now pass on to two others of a very different character; the first of these is a cerebral affection, which is apt to occur in the course of some—

VII. *Dropsies.*

1848. Dr. Wells, of St. Thomas's Hospital, was amongst the first to draw the attention of the profession to the frequent presence of albumen in the urine of patients affected with dropsies, preceded or unpreceded by scarlatina, in two most admirable papers, published in the "Transactions of a Society for Promoting Medical and Surgical Knowledge," vol. iii. p. 167 and p. 147. Dr. Wells's observations have been amply confirmed by Dr. Blackall, Dr. Bright, &c.

1849. In the midst of such a disease the patient is not unfrequently attacked with symptoms denoting a cerebral or true spinal affection. There are delirium, or coma, or convulsions; apoplexy, hæmorrhage, hemiplegia; or meningitis.

1850. I have already, more than once, alluded to such an affection in children. Dr. Wells mentions this affection, p. 177; Dr. Bright gives such a case in his "Medical Reports," vol. i. p. 97; there was, in this last case, "a slight serous effusion under the arachnoid." The subject is in need of renewed investigation. See *particularly* § 725—; 886—.

1851. In diabetes and other morbid states of the urine, cerebral affections are apt to supervene.

VIII. *Ischuria.*

1852. The next disease to which I must refer you as intimately connected with the brain, is ischuria, or suppression of the urine, to which may be added other morbid conditions of this secretion, besides that marked by the presence of albumen. Dr. Prout*, Dr. Abercrombie†, and Dr. Wilson‡, have lately treated this subject.

1853. There is frequently considerable disease of the kidneys. The suppression may be partial or complete; it

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* On the Affections of the Urinary Organs.

† The Edin. Med. and Surg. Journ. ‡ The Medical Gazette.

leads to fever, thirst, a urinous taste in the mouth and smell of the perspiration, nausea, vomiting, hiccup, delirium, coma, convulsions.

1854. It was necessary that I should enter into these brief details; otherwise the *sketch* of my subject would have been incomplete. When the whole outline is filled up, I flatter myself that it will present a work of great *practical* as well as scientific interest, and I trust that I shall be enabled to accomplish this before many years have passed away.

POSTSCRIPT.

1855. In this postscript I take the liberty of adding several remarks which escaped me at the time of discussing the various subjects to which they refer.

1856. In reference to the subject of § 1473, I may now mention that there was *atrophy*, to the extent of a space which might be covered with half-a-crown, of the upper part of the left hemisphere of the cerebrum and of the adjacent parietal bone. The cranium was thinner there than in the corresponding part of the other parietal bone; and the cortical substance had disappeared; without, however, any ulceration, or interruption of texture.

1857. The movements which precede sneezing, and sneezing itself, may frequently be arrested by forcibly rubbing the point of the nose. A fresh excitement is induced in another branch of the trifacial nerve, by which the former one is superseded.

1858. In this manner, I think, to induce vomiting, frequently supersedes other and more formidable excitements of the true spinal system: thus, the crowing inspiration and its frequent issue, convulsion, thus, the fit of epilepsy,—is frequently prevented. Irritating substances may also be thus removed from the stomach, and the healthy secretions of the liver and other digestive organs may be promoted.

1859. However this may be, I have this very day evidence of the efficacy of this remedy, in the prevention of convulsion in a little girl, and in two cases of epilepsy.

1860. I need scarcely remark how pertussis and asthma are relieved by the same means.

1861. In illustration of the observation made § 1454, that the pathology of mania is frequently *intra-vascular*, besides the facts of exhaustion and chlorosis, and mental shock, I may mention the occurrence of mania after puerperal convulsion and epilepsy; the former is noticed by Mr. Ingleby, the latter I have myself witnessed in a pupil. The congestion does not subside into health; but into a state which proves the cause of aberration of the ideas.

1862. I propose shortly to treat of the special forms of mania, and of nervous diseases bordering on mania, in the female sex; and I would further propose to establish an *Asylum* for the treatment, and I think I may say the cure, of these cases.

EXPLANATION OF THE PLATES.

PLATE I.

This plate represents the true spinal, or excito-motory, system, or system of ingestion and egestion.

The cerebrum and cerebellum, the seat or centre of sensation and of volition, and of all the mental or psychical faculties, are *removed*, and with them all psychical phenomena, inclusive of sensation and spontaneous motion.

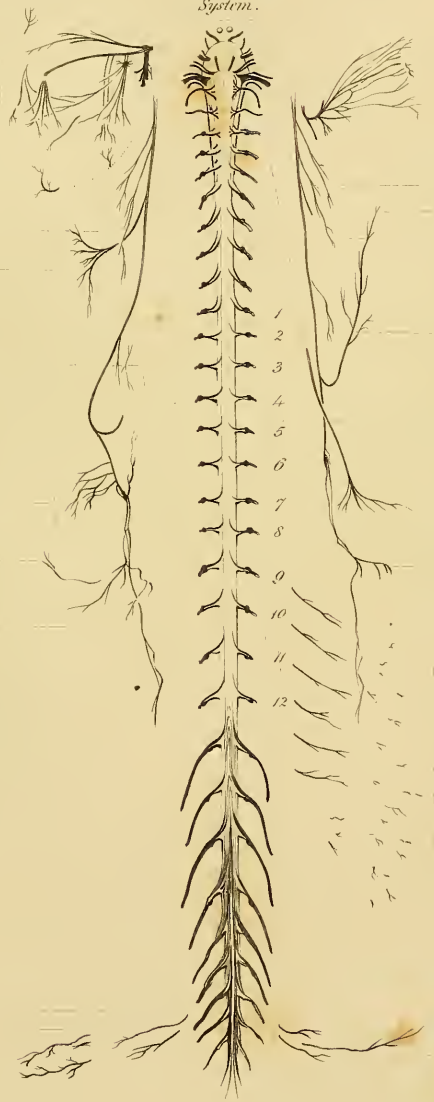
The true spinal marrow, the medulla oblongata, and the medulla spinalis, the centre of the true spinal system, *remain* in connection with the incident excitor nerves on the *left* hand, and the motor nerves direct and reflex on the *right*.

The True Spinal System.

I.
Excitor Nerves,
from Cutaneous and Mucous surfaces,
to the Spinal Cord.

II.
Centre of the System.

III.
Motor Nerves,
to their appropriate Muscles,
from the Spinal Cord.



Charles Simpson, Surgeon,
Stamford, Dec.r

PLATE II.

Figure 1 of this plate represents the cerebral system,—the cerebrum, the cerebellum, with the sentient nerves and the nerves of voluntary motion, and the *spinal cord* of cerebral nerves.

The curved lines denote the decussation of the cerebral fibres, in the medulla oblongata.

The lines, A B, C D, E F, G H, H I, denote the effects of paralysis—1, of the cerebrum; 2, of the cerebrum and medulla oblongata; and 3, of these and the medulla spinalis, particularly described p. 268.

Figure 2 displays the ganglionic system, comprising the spinal marrow, the trifacial, pneumogastric, and spinal nerves, with the ganglia on their roots and in their course, and the ganglionic system of the neck, thorax, and abdomen.

This may be compared with *figure* 4 of *Plate* VI.

I. *Diagram of the Cerebral System.*

II. *Diagram of the Ganglionic System.*

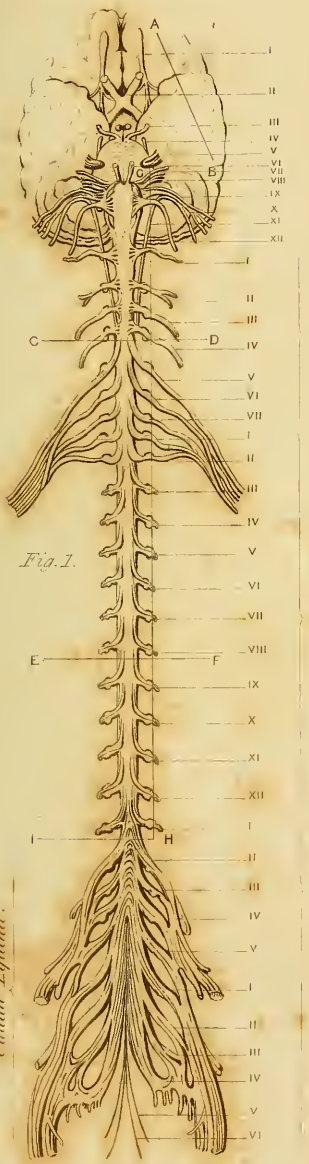


Fig. 1.

Fig. 2.

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PLATE III.

In this plate, *figure* 1 represents a frog in which the spinal marrow has been divided, in one experiment *above*, in a second *below*, the origin of the brachial plexus.

In the second case, we see the phenomena of sensation and volition in the anterior extremities, and those of the excito-motory action, without sensation and volition, in the posterior.

But having also applied a ligature on the right sciatic nerve, we observe the limb to be paralysed in every respect; that is, to both the cerebral and the true spinal functions. After a considerable interval, we observe the left posterior extremity to be endowed with augmented irritability, but the right to present diminution of this power.

Figures 2, 3, 4, and 5, represent the *demonstration*, judging from the *facts* or *phenomena* alone, that the *vis nervosa* of Haller *(fig.* 2*)*, and the principle of the reflex actions and function *(fig.* 5*)*, are one and the same motor power. This demonstration is established through the discovery of new *laws* of action *(fig.* 3 and 4*)* of the *vis nervosa*.

Figures 6, 7, 8, 9, 10, denote very important *pathological* facts:

Figure 6 shows that if the central organ of any reflex function be injured, the function must cease; and *figure* 7, that if *either* the *incident* or *reflex* nerve be injured, the same effect ensues.

Figure 8 shows the true spinal marrow acting in distinct *horizontal segments;* whilst the *figures* 9 and 10 demonstrate *similar segments*, as it were, taken *vertically; figure* 9 denoting the action of the true spinal marrow *from above downwards*, as in the case of *dentition*, disease, or experiment; and *figure* 10, a similar but *retrograde* action *from below upwards*, as in the case of intestinal or uterine irritation, and also in disease (§ 1211—,) and in experiment.

Figures 2, 3, and 5.—proofs that the Excito-Motor Power is identical with the Vis Nervosa of Haller.

Fig. 1

Vis Nervosa of Haller.

Fig. 2.

Reflex Actions.

Fig. 5.

Fig. 1

Fig. 2.

Fig. 5

Reflex Actions.

Direct Actions.

Fig. 3.

Fig. 4

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

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PLATE IV.

Figure 1 represents the closure of the eye-lid, as a reflex act, when, the influence of the cerebrum being removed, the border of the eye-lid or the conjunctiva is irritated.

Figure 2 represents the act of *deglutition*. The pharynx acts on the principle of the reflex function, the larynx being simultaneously closed; the œsophagus acts *both* on the same principle, as ascertained by Dr. J. Reid, *and* on the usual principle of *immediate* stimulus, as observed in experiments by myself; the *cardia* is opened as a synergetic *action*. The office of the glosso-pharyngeal, as denoted by a note of interrogation, is still doubtful.

Figure 3 pourtrays a most interesting application of our recently acquired knowledge of the reflex function: the *pharyngeal* is substituted for the *œsophageal* tube. See § 362—.

Figures 4 and 5 represent the feather and probang, noticed § 376—; *figure* 6, the *cane*, mentioned § 389; and *figure* 7, the *catheter*, mentioned § 401.

Diagram of the Closure of the Eye lid.

Fig. 1.

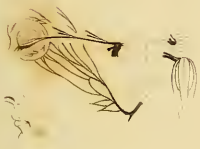
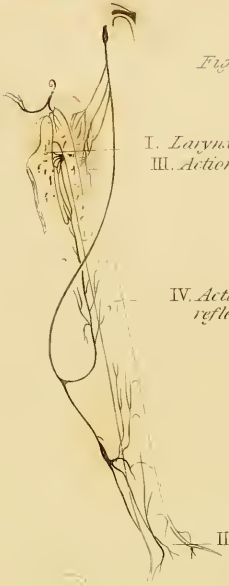


Diagram of Deglutition.

Fig. 2.



I. *Larynx closed.*
III. *Action of Pharynx reflex.*
IV. *Action of Œsophagus reflex and immediate.*
II. *Cardia opened.*

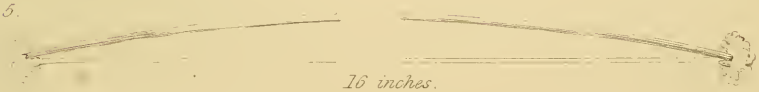
Diagram of the Use of the Pharyngeal Tube.

Fig. 3.

Fig. 4.

9 inches.

Fig. 5.



16 inches.

Fig. 6

8 inches.

Fig. 7.

5½ inches.

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PLATE V.

Figure 1 of this plate pourtrays the all-important reflex function of *respiration :* 1, the medulla oblongata represents the *centre* of the respiratory system, the discovery of Legallois, viewed as the primum mobile of this formation by that eminent physiologist, by M. Flourens, by Sir C. Bell, &c.; 2, on the *right* are given the *motor* nerves of respiration, associated as such by Sir Charles Bell; 3, on the *left* are pourtrayed the *excitor* nerves of respiration, the real prima mobilia of this function, and *as such* my own important discovery; 4, the *whole* are associated as constituting the nervous system of respiration, as an *excito-motory act*, equally my own view of this important subject. It must be remembered too, that respiration so viewed is only a part of the more general system of reflex functions.

Figure 2 represents respiration as *excited* by a stimulus applied to the divided end of the medulla oblongata, and of the pneumogastric nerve, and to the nostril, the palatine fringes, and the larynx, in the separated head of the tortoise.

Figure 3 displays the interesting fact, recently observed by myself, that *each* ganglion along the chain of ganglia, in the dragonfly, is an *analogue* of the *medulla oblongata*, as the central organ of respiration.

Diagram of Respiration.

IV. Respiration an Excito-motory Act.

III. The Author's View. II. Sir Chas Bell's View.

I. Legallois' Discovery.

Trifacial. V.

Cutaneous Excito-Nerves of Respiration

The Pneumogastric or Internal Excito-motory Nerves of Respiration.

Fig. 1.

The Facial. V.

Super: Ext. Respiratory. V. of Bell.

Infer: Ext. Respiratory. V. of Bell.

Super: Intercostals.

The Diaphragmatic. V.

Infer: Intercostals, distributed also to the Abdominal muscles.

Fig. 2.

Fig. 3.

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PLATE VI.

Figure 1 represents *vomiting* as a reflex action; the *excitors*, viz. the *trifacial* in the fauces, the *pneumogastric* in the stomach, the gall-duct, the ureter, the *spinal* in the intestine, the uterus, &c. are placed on the *left;* the medulla oblongata in the *centre;* the *recurrent* of the *pneumogastric*, the closer of the larynx, and the *intercostal* as the motors in expiration, are placed on the *right* hand.

Figure 2 represents the recurrent of the trifacial, discovered by Arnold, and noticed § 552; and *figure* 3, the manner in which the spinal marrow, the ganglia on the posterior roots of the spinal nerves, and the ganglia of the sympathetic, are combined in one system, taken from a sketch by Sir C. Bell, made with another object. Compare with *Plate* II, *figure* 2.

Figure 4 represents the important case of the *crowing inspiration* and *convulsion;* and may be considered as the *type* of a *Class* of diseases.

The *excitors*, as in dental, gastric, intestinal irritation, are arranged on the *left* hand of the left part of the diagram; the *motors*, inducing *partial closure* of the *larynx* and a *sudden* inspiration, and as affecting the flow of the bile and of the urine, &c. are pourtrayed on the *right* hand; in the right part of the diagram the *larynx* is represented as *closed*, whilst there is a violent *effort* of *expiration;* these latter facts constituting the important difference between these two *forms* of the disease.

Diagram of Vomiting.

Fig. 1

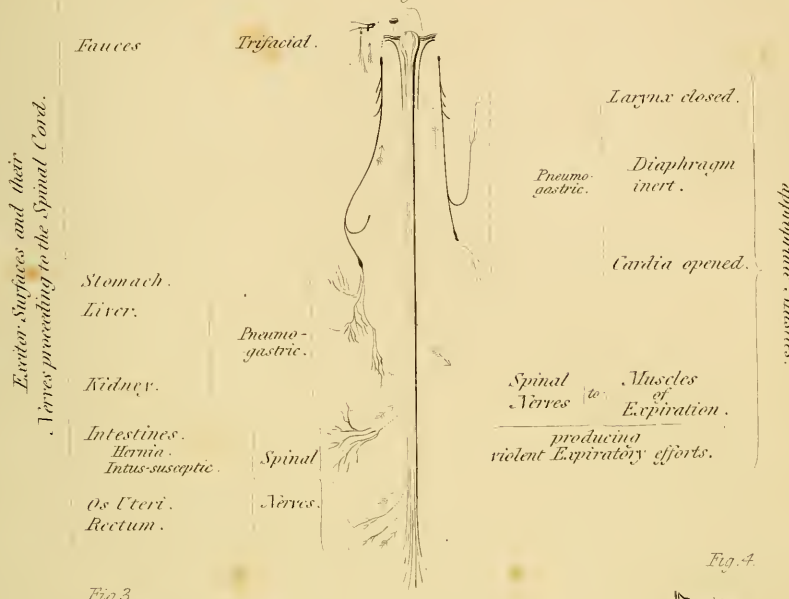

Fig. 3

Fig. 4

Diagram of Crowing Inspiration proceeding to Convulsion.

Fig 2

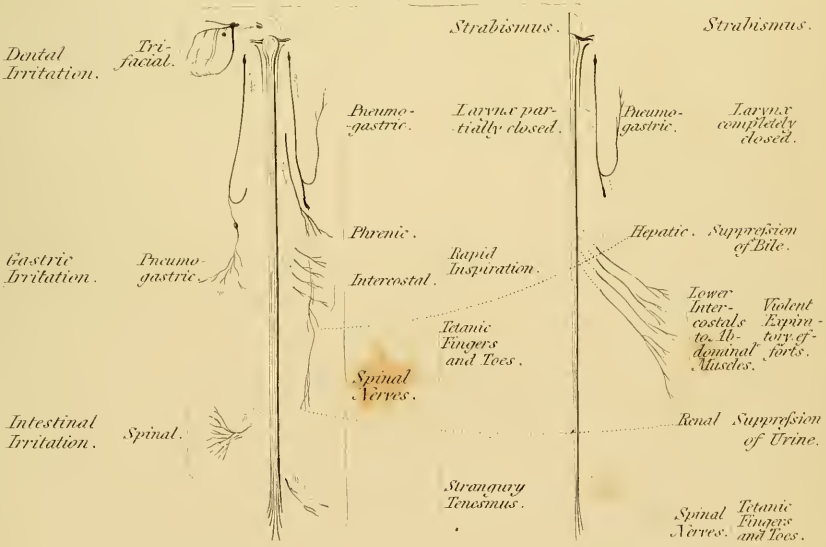

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PLATE VII.

Figure 1 represents *hemiplegia* of the *face*. The *features* are drawn to the *unaffected* side, but the *tongue* is protruded *to* the *paralytic* side, by the action of the genio-glossal muscle; the eye-lid is closed, but not so firmly as that of the healthy side.

Figure 2 represents the *spasmodic tic:* the *features* are drawn *to* the *affected* side; the eye-lid is closed *imperfectly and irregularly.*

Figures 3 & 4 represent paralysis of the *facial* nerve; in this case the *eye-lid cannot be closed;* the *features* are drawn *to* the *unaffected* side; but the *tongue* is protruded naturally. Of the *infant,* it was said by its mother, that "it smiled and cried with one side of its mouth."

These figures are reduced from drawings by Mr. Waterhouse Hawkins.

Figure 5 represents the hand *contracted* by the *direct* action of the *vis nervosa,* in *chronic hemiplegia.*

Figure 6 pourtrays the ring-finger contracted into the *palm,* as by a *spring,* in spinal arachnitis. § 1285.

Figures 7, 8, 9, pourtray the position of the pen, in the case described § 1283. The case is allied to *stammering,* only being an affection of another class of muscles.

Figures 10 and 11 depict the condition often observed in the *convulsive* affections of children from *dentition,* &c. (See § 1288); and

Figures 12 and 13, the condition termed wrist-drop, and the emaciated condition of the flexors of the thumb, in the *paralysis from lead.*

These figures are reduced from drawings for which I am indebted to Mr. Egley.

Paralysis of the Facial Nerve.

Hemiplegia.

Fig. 1.

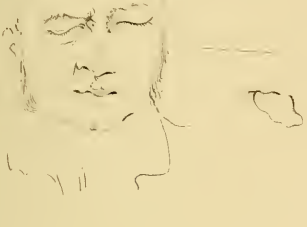

Fig. 2.

Spasmodic Tic.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

J. Bull. Sculp.

PLATE VIII.

Figure 1 represents *meningeal hæmorrhagy*, from Cheyne.

Figure 2 pourtrays *cerebral hæmorrhagy*, extending into the *ventricles; figure* 3, *cerebral hæmorrhagy* limited to the hemisphere.

Figure 4 pourtrays hæmorrhagy of the *tuber annulare*.

Figure 5 depicts hæmorrhagy in which the clot of blood pressed on the medulla oblongata.

Figure 6 is a sketch of the most interesting case of Mr. Barlow, given § 1144; and *figure* 7, that of the equally interesting case of Mr. Brayne, given § 1286.

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Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 7.

Fig. 6.

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Stamford, Del.

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